Chapter 13

Integrating Smell Sense in Robots Using Artificial Neural Networks

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ABSTRACT

One of the approaches to mimic the remarkable abilities of the human olfactory system is by the design of computer-controlled sensor arrays that are capable of detecting and distinguishing a different range of smells and odors with consistent monitoring, referred to as electronic noses. This chapter introduces the opportunity of integrating smell sense in robots by the use of artificial neural networks. The study proposes a structure for integrating electronic noses in robots to add the capabilities of smell-related assignments, typically to recognize hazardous substances such as sampling the air and decide its actions based on this information. Utilizing the proposed algorithm allows experts in this field to be aware of gas leakage areas and thus reduce unexpected incidences. The effectiveness of the algorithm is demonstrated using real-world samples, and the performance is examined via quantitative metrics and analysis. The results show that the proposed algorithmic framework outperforms state-of-the-art methods with an error rate of only 0.0999%.

BACKGROUND

A tremendous amount of researches have been conducted in the area of robotics, resulting in innumerable advancements in this technology. The developments in robotics can range from solving Rubik’s cube in less than a second time to deep-diving robots zap, to dancing droids that dance simultaneously.

Along these lines, robots can turn into the eyes, ears, and even noses of humans permitting an appropriate intervention when required.

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On the other hand, during the last few decades, the electronic nose has been applied to a number of disciplines. Many systems have been developed to explore, for example, the odor highlight of tests, and human evaluation has been the fundamental instrument of diagnosis. From an evolutionary perspective, the chemical senses, particularly olfaction, are coined as the oldest sensory systems. They remain in many ways the least understood systems of the sensory modalities. The olfactory system is the most thoroughly studied component of the chemo-sensory triad and processes information about the identity, concentration, and quality of a wide range of chemical stimuli. There are many models available that simulate human sensors. These stimuli, called odorants, interact with olfactory receptor neurons within an epithelial sheet, the olfactory epithelium that lines the interior of the nose. Similar to the way road atlases map out different real-world locations, the brain configures itself a map of our physical world. One such map is the olfactory system, which represents one of the oldest sense models in the history of mammals. This system has been long believed to map in such a way that those groups of chemically related odorants index with clusters of cells that are situated next to one another.

Our focus in this chapter is odor-sensing robots that have the ability to distinguish between different significant odors, as this technology has a great advantage for the humanity. For example robots with the capability of sensing odors can replace trained sniffer dogs to locate different substances such as illegal drugs, victims of natural disasters, escaped prisoners, explosives, earthquakes, wildlife scat, chemical leaks, currency, or blood. The shocking fact that the behaviour of those trained dogs might be affected by their trainers believes (Li and Hopfield, 1989) leads us to emphasise and rethink in other alternatives such as odor-sensing robots. The magnificent number of mistaken alarms distinguished crosswise over conditions affirms that handler convictions influence performance. Moreover, the coordinated example of cautions in conditions containing a marker contrasted with the pattern of alarms in the condition with unmarked fake fragrance proposes that human impact on handler convictions influences alerts to a more prominent degree than dog impact on handler convictions. That is, the otal number of alarms distinguished by handlers did not vary crosswise over conditions.

Researches in the area of robotics have begun to examine the challenges and capabilities of electronic noses that utilize chemical sensors in the late 1980s and early 1990s. Various applications utilize chemical sensors to provide a guide for odor-sensing robotics.

At the point when confronting a bomb risk, officers can survey the circumstance through the camera introduced on the robot. On the off chance that the hazardous gadget can be examined by the robot, the administrator can utilize the robot’s hand to grab the gadget and take it to a sheltered place for explosion.

Robots nowadays are widely used as they are robust, easy to set up, have low maintenance, low risk of technology failure, and easy to troubleshoot.

Moreover, increasing the sensitivity of the sensor opens up numerous trends. The sensor will likewise be utilized as a part of an unconstrained situation and therefore should resist being damaged by the chemicals it will encounter in its environment.

The reminder of the chapter is organized in the following manner. The chapter starts by introducing the concept of electronic noses. In the second part, this chapter illustrates artificial neural networks and a review of related literature is introduced. Finally, in this chapter data sampling and the methodology used with the findings of the research work are described.