11.1 Introduction

11.1.1 The Importance of Simulation

As the length of medical training time decreases and the expected knowledge base of healthcare providers increases, simulation is often being called on as an educational supplement to real-world experiences [13, 15]. This is especially true in those cases where physical distance is a hindrance to receiving proper medical training [9, 16]. Regardless of whether or not distance is the issue, medical simulators have recently been shown to be efficacious, supplemental educational aids when it comes to teaching the complexities of surgery [7] and emergency room medicine [14].

At advanced, complex training levels, such as learning by way of the surgical simulator, it is important that the appropriate clinical clues be incorporated into simulated systems, in order to support high-level decision making [5]. Students often complain that the lack of clinical realism associated with many medical simulators is an important limitation [5]. In order to create a strong sense of presence in the virtual environment, the traditional modalities of touch, hearing, and vision must be superseded. For these reasons, in addition to the fact that simulators play a supplemental role to real-world clinical experiences, it is important that virtual technologies provide the student with as much realism as possible, including details that have historically been considered technically out of reach, such as appealing to the human sense of smell.

11.1.2 The Sense of Smell and Medicine

In traditional Chinese medicine, the sense of smell has always been recognized as a valuable medical diagnostic tool [3]. Doctors are taught to use the
sense of smell to recognize disorders even before a patient begins exhibiting symptoms, and the importance of smell, for the purposes of diagnosis, can be universally applied to the practice of medicine in general [1, 4, 19]. For example, clinicians are trained to recognize the smell of pears (acetone) on a patient’s breath as being indicative of diabetes [1, 4, 6, 19]. Syphilis, kidney failure, abscesses of the lung, uremia, scurvy, liver failure, typhoid, scrofula, smallpox, rheumatic fever, diphtheria, pneumonia, and scarlet fever are also just a few of the conditions described by clinicians as having distinctive odors. In addition, odors that can be associated with surgery, such as infected wounds, human tissues, and human body fluids such as blood or bile, have also been considered in terms of telepresent surgical applications [12].

11.2 Scent Technology

There are a number of companies currently developing computerized olfactory technologies. Some of the more widely known developers include Aromajet, British Telecom, Aerome, Trisenx, Osmooze, AC2i, ScentIT, ScentAir, and DaleAir [10, 11]. Although their designs vary, the fundamental supporting technology behind computerized scent generally falls into one of five categories: inkjet systems, wax-based systems, airbrush systems, microencapsulated systems, or heated-oil systems. When considering medical simulators that incorporate the sense of smell into their framework, the design of the olfactory system is less important than the fact that the technology exists. Because scents can be customized, depending on the simulated environment, any contemporary computerized scent device could be made to work.

One of the more common types of computerized scent technologies is the heated oil and fan design. The “Scent Dome,” an example of this type of design, can be purchased from a Georgia-based company called Trisenx [17]. The Scent Dome (Fig. 11.1), which is approximately 14 cm wide, 20.5 cm long, and 6.5 cm tall, plugs into a standard COMM or USB port and is powered by four D batteries or optional adapter. Each Scent Dome comes standard with one interchangeable scent cartridge [18]. Each scent cartridge contains 20 distinct chambers, with 20 distinct vials of preselected scented oils, the combinations of which can create thousands of aromas.

The Scent Dome itself is controlled by way of a graphical user interface. This proprietary computer software, called Senxware, allows the user to mix and match aromas by way of a virtual beaker or to activate one of the preprogrammed aromas [18]. After a scent is created, and the Scent Dome software activates the unit for dispersion, the software communicates with the Scent Dome via a serial (or USB) connection, at which time the selected chambers are