

**SAFFIR (SHIPBOARD AUTONOMOUS FIREFIGHTING ROBOT)** Fire on a ship is one of the greatest risks to shipboard life. Shipboard fires have a different and crucial set of problems. Because of the confined space, there are challenges regarding smoke, gas, and limited ability to escape. Even though procedures like fire drills, onboard alarms, fire extinguishers, and other measures provide ways of dealing with fire on the sea, modern technology is in place to tackle this threat in a better way. A U.S. Navy team at the Office of Naval Research has developed SAFFiR. It is a 5 foot 10 inch tall robot. It is not designed to be completely autonomous. It has a humanoid robotic structure so that it can pass through confined aisles and other nooks and corners of a ship and climb ladders. The robot has been designed to work with the obstacles in the passageways in a ship. SAFFiR can use protective fire gear such as fire-protective coats, suppressants, and sensors that are designed for humans. Lightweight and low-friction linear actuators improve its efficiency and control. It is equipped with several sensors: regular camera, gas, and infrared camera for night vision and in black smoke. Its body is designed not only to be fire resistant but also to throw extinguishing grenades. It can work for around half an hour without needing a charge. SAFFiR can also balance itself on an uneven surface.

Compiled from K. Drummond. (2012, March 8). "Navy's Newest Robot Is a Mechanized Firefighter." **wired.com**. <https://www.wired.com/2012/03/firefight-robot/> (accessed September 2018); P. Shadbolt. (2015, February 15). "U.S. Navy Unveils Robotic Firefighter." CNN. <https://www.cnn.com/2015/02/12/tech/mci-saffir-robot/index.html> (accessed September 2018); T. White. (2015, February 4). "Making Sailors 'SAFFiR' – Navy Unveils Firefighting Robot Prototype at Naval Tech EXPO." America's Navy. [https://www.navy.mil/submit/display.asp?story\\_id=85459](https://www.navy.mil/submit/display.asp?story_id=85459) (accessed September 2018).

## Pepper

Pepper is a semihumanoid robot manufactured by SoftBank Robotics that can understand human emotions. A screen is located on its chest. It can identify frowning, tone of voice, smiling, and user actions such as the angle of a person's head and crossed fingers. This way Pepper can determine if a person's mood is good or bad. Pepper can walk autonomously, recognize individuals, and can even lift their mood through its conversation.

Pepper has a height of 120 cms (about 4 feet). It has three directional wheels attached, enabling it to move all around the place. It can tilt its head and move its arms and fingers and is equipped with two high-definition cameras to understand the environment. Because of its anticollision functionalities, Pepper reduces unexpected collisions and can recognize humans as well as obstacles nearby. It can also remember human faces and accepts smartphone and card payments. Pepper supports commands in Japanese, English, and Chinese.

Pepper is deployed in service industries as well as homes. It has several advantages for effectively communicating with customers but has also been criticized at places for incompetence or security issues. The following examples provide information on its applications and drawbacks:

- Interacting with robots while shopping is changing the face of AI in commercial settings. Nestlé Japan, a leading coffee manufacturer, has employed Pepper to sell Nescafé machines to enhance customer experience. Pepper can explain the range of products Nestlé has to offer and recognize human responses using facial recognition and sounds. Using a series of questions and responses to them, the robot identifies a consumer's need and can recommend the appropriate product.
- Some hotels such as Courtyard by Marriott and Mandarin Oriental are employing Pepper to increase customer satisfaction and efficiency. The hotels use Pepper to increase customer engagement, guide guests toward activities that are taking

place, and promote their reward programs. Another goal is to collect customer data and fine-tune the communication according to customer preferences. Pepper was deployed steps away from the entry at Disneyland theme park hotels, and it immediately increased customer interactions. Hotels use Pepper to converse with guests while they are checking in or out or to guide them to the spa, gym, and other amenities. It can also inform guests about campaigns and promotions and help staff members avoid the mundane task of enrolling guests in a loyalty program. Customer reactions are largely quite positive in regard to this.

- Central Electric Cooperative (CEC), an electric distribution cooperative located in Stillwater, Oklahoma, has installed Pepper to monitor outages. CEC serves more than 20,000 customers in seven counties in Oklahoma. Pepper is connected to the operations center to read information about live outages, and by connecting them to geographic information system (GIS) maps it can also inform operations about the live locations of service trucks. At CEC, Pepper is also used for conferences where attendees can know more about the company and its services. Pepper answers a range of questions regarding energy consumption. In the future, the company plans to invest more in robots to meet its requirements. See Figure 10.2 that shows Pepper participating as a team member during a prospective employee interview to provide input about CEC's programs and so on.
- Fabio, a Pepper robot, was installed as a retail assistant at an upmarket food and wine store in England and Scotland. A week after implementing it, the store pulled the service because it was confusing customers, and they preferred the service from personal staff rather than Fabio. It provided generic answers on queries such as the shelf location of items. However, it failed to understand completely what the customer was requesting due to background noise. Fabio was provided another chance by placing it in a specific area that attracted only a few customers. Then they also complained about Fabio's inability to move around the supermarket and direct them to a specific section. Surprisingly, the staff at the market became accustomed to Fabio rather than considering it as a competitor.



**FIGURE 10.2** Pepper Robot as a Participant in a Group Meeting. *Source:* Central Electric Cooperative.

- Pepper has several security concerns that were pointed out by Scandinavian researchers. According to them, it is easy to have unauthenticated root-level access to the bot. They also found the robot to be prone to brute force attack. Pepper's functions can be programmed using various application programming interfaces (APIs) through languages such as Python, Java, and C++. This feature can cause it to provide access to all its sensors, making it not secure. An attacker can establish a connection and then use Pepper's mic, camera, and other features to spy on people and their conversations. This is an ongoing issue for many robots and smart speakers.

Compiled from "Pepper Humanoid robot helps out at hotels in two of the nation's most-visited destinations (2017)". SoftBank Robotics. <https://usblog.softbankrobotics.com/pepper-heads-to-hospitality-humanoid-robot-helps-out-at-hotels-in-two-of-the-nations-most-visited-destinations> (accessed November 2018); R. Chirgwin. (2018, May 29). "Softbank's 'Pepper' Robot Is a Security Joke." The Register. [https://www.theregister.co.uk/2018/05/29/softbank\\_pepper\\_robot\\_multiple\\_basic\\_security\\_flaws/](https://www.theregister.co.uk/2018/05/29/softbank_pepper_robot_multiple_basic_security_flaws/) (accessed September 2018); A. France. (2014, December 1). "Nestlé Employs Fleet of Robots to Sell Coffee Machines in Japan." *The Guardian*. <https://www.theguardian.com/technology/2014/dec/01/nestle-robots-coffee-machines-japan-george-looney-pepper-android-softbank> (accessed September 2018); Jiji. (2017, November 21). "SoftBank Upgrades Humanoid Robot Pepper." *The Japan Times*. <https://www.japantimes.co.jp/news/2017/11/21/business/tech/softbank-upgrades-humanoid-robot-pepper/#.W6B3qPZFzIV> (accessed September 2018); C. Prasad. (2018, January 22). "Fabio, the Pepper Robot, Fired for 'Incompetence' at Edinburgh Store." *IBN Times*. <https://www.ibntimes.com/fabio-pepper-robot-fired-incompetence-edinburgh-store-2643653> (accessed September 2018).

## Da Vinci Surgical System

Over the last decade, the use of robotics has emerged in surgeries. One of the most famous robotic systems used in surgery is the Da Vinci system that has performed thousands of surgeries. According to surgeons, Da Vinci is the most ubiquitous robot used in more units than any other robot. It is designed to perform numerous nominally invasive operations and can perform simple as well as complex and delicate surgeries. The critical components of Da Vinci are the surgeon console, patient side cart, endowrist instruments, and vision system.

The surgeon console is where the surgeon operates the machine. It provides a high-definition, 3D image of the inside of the patient's body. The console has master controls that a surgeon can grasp by the robotic fingers and operate on the patient. The movements are accurate and in real time, and the surgeon is entirely in control and can prevent the robotic fingers from moving by themselves. The patient side cart is the location where the patient resides during the operation. It has either three or four arms attached that the surgeon controls using master controls, and each arm has certain fixed pivot points around which the arms move. The third component is the endowrist instruments, which are available while performing surgery. They have a total of seven degrees of freedom, and each instrument is designed for a specific purpose. Levers can be released quickly for a change of instruments. The last component is a vision system, which has a high-definition, 3D endoscope and image-processing device that provides real-life images of the patient's anatomy. A viewing monitor also helps the surgeon by providing a broad perspective during the process.

Patients who have surgery that used the Da Vinci system heal faster than those performed by traditional methods because the cuts by robotic arms are quite small and precise. A surgeon must undergo online and hands-on training and must perform at least five surgeries in front of a surgeon who is certified to use the Da Vinci system. This technology does increase the cost of the surgery, but its ability to ease pain while increasing precision makes it the future of such procedures.

Compiled from "Da Vinci Robotic Prostatectomy – A Modern Surgery Choice!" (2018). Robotic Oncology. <https://www.roboticoncology.com/da-vinci-robotic-prostatectomy/> (accessed September 2018); "The da Vinci® Surgical System." (2015, September). Da Vinci Surgery. <http://www.davincisurgery.com/da-vinci-surgery/da-vinci-surgical-system/> (accessed September 2018).