HOSPITAL CLEANING ROBOT

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The purpose of this robot is to prevent and reduce in-hospital acquired infections, especially those caused by virus and bacteria, to make available a cleaning procedure that can be executed in a systematic and uninterrupted way, and to allow gains in quality and productivity that may let human resources for health focus on other tasks.

Millions of patients are hospitalized worldwide every year. In Europe, for example, it is estimated that around two million will contract infections caused by bacteria gram-negative symptoms present in hospitals, with high mortality. In the United States, infections acquired in hospitals are the sixth leading cause of death in the country, resulting in annual costs between 5 and 10 billion dollars. The elimination of viruses and bacteria thus appears to be of crucial importance, especially now with the pandemic situation in which we find ourselves.
Ultraviolet C (UVC) light technology is already well known, and has been used for over 40 years in hospital and pharmaceutical environments, with the purpose of cleaning out the air, water, equipment, materials, among others. This type of radiation damages the genetic structure of the microorganisms, inactivating any virus or microorganism. The key variable is the dose of radiation, that is, the time of exposition to the UVC light. This is well documented in the literature, and therefore, it is possible to calculate both the power and distance that is required for all the microorganisms to be deactivated.
Not long ago, this type of systems needed to be operated manually, which implied having an operator deciding where to put the lights and programming the timer. After a while, the operator needs to return to the site in order to change the location of the lamps and repeat the process. Depending on the furniture (beds, chairs, among others), this procedure may have to be repeated for each room, dorm or ward, becoming burdensome and taking too much time of the operators.
By the means of this autonomous robot, it is possible to perform, in a fully automated way, this sequence of operations, freeing human resources to other tasks.
After obtaining the map for the site, which is obtained by the robot, it is possible to specify locations to be cleaned, how long should the UVC lights be on, and have it return to the base station, where it will charge the batteries (Figure 1). The robot is also equipped with a module, based on motion and thermal sensors, that is able to detect the presence of human beings, immediately turning off the UVC lights, since this radiation causes harm to any organism. The time during which it is deactivated will be taken into consideration in order to ensure that enough UVC light is emitted to sterilize the site. The inclusion of thermal sensors, aside from the motion sensors, is capable of detecting people (or any hot-blood organisms), even if they are standing still, for instance while in their sleep. This is a failsafe mechanism, as the motion sensors would fail to detect the presence of human beings.

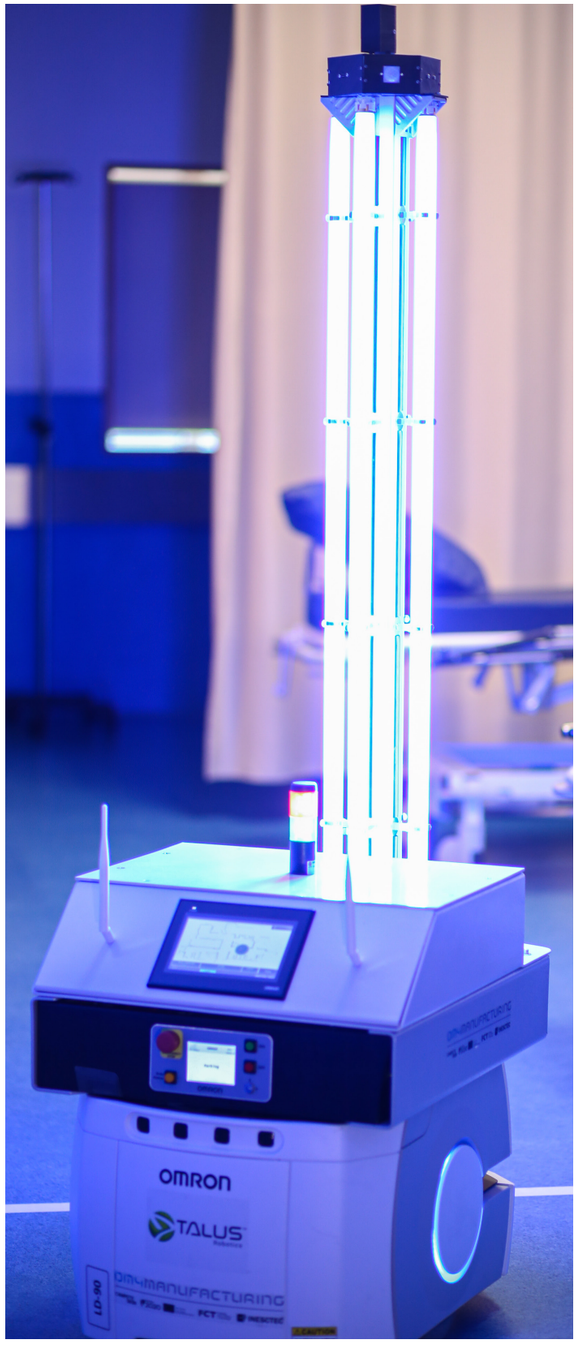

Figure 1 - Hospital cleaning robot.

After the initial programming and configuration, the robot's interface is easy to setup and use, allowing any person to operate the robot, provided they receive a quick training or read the instructor's manual.
In the near future, further work will be developed in order to make the robot more intelligent and autonomous. The idea is for the robot to decide, in an optimal and intelligent way, which routes to take, pit stops, how long it should stay with the UVC lights activated, or if it should continue moving at a constant speed and with the lights on. All will be calculated and decided based on the site to clean. To be able to do this, the robot will first have to draw a 3D layout of the room, using a 3D laser sensor, and with that information decide in an optimal way how to proceed.
The main contribution of this Project is then to reduce the transmission of infectious diseases caused by virus and bacteria that live in hospital settings, providing a systematic and uninterrupted cleaning procedure that will generate gains in terms of quality and productivity, freeing human resources to perform other tasks.
In addition, health care professionals will be less exposed to toxic or corrosive material that is typically used in traditional cleaning procedures.
The validation tests were performed at the Hospital of S. Martinho, in Valongo. According to João Sobral, member of the hospital, this robot is extremely interesting, since it is a way to reduce in-hospital acquired infections.

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