INTERNATIONAL DEVELOPMENT PLANNING REVIEW
ISSN:1474-6743 | E-ISSN:1478-3401

A CONCEPTUAL FRAMEWORK OF SMART ROBOTIC FOR CLINICAL WASTE HANDLING

Mohd. Mursleen,
Department of Computer Applications, Tula's Institute, Dehradun
Mr. Devendra Sood
Department of Computer Applications, Tula's Institute, Dehradun

Abstract
Corona virus pandemic attacked the world's population. There is no exception in the waste management system in the process of sorting, cleaning, disposal and disinfection. Improper handling of clinical waste can pose a risk of virus infection and transmission to the public, as well as a risk of unsterile atmosphere in hospitals when in contact with humans. Smart robotic (SR) in the healthcare sector will certainly improve the above-mentioned issues\ and however, in actual application, remain limited. The research goals are, firstly, to design and develop a stand-alone robotic platform to support clinical waste disposal through a predetermined pathway and, secondly, to develop a robotic system framework fitted with a disinfection module to complement the disposal handling process. The SR has safety requirements including adequate circuit and main controller with waterproof protection and smart charger, high-capacity lead-acid battery, and low-voltage robot retainer. It also has multiple sensory systems to automatically direct the robot along the intended pathway. In addition, a high-pressure pump, a mist sprayer and a storage tank sanitizer are installed on the system. Therefore, the disease transmission will be minimized with this self-sanitizing equipment that integrates on the system. The advantages are reduced radiation exposure, increased reliability, and cost savings against clinical waste management facilities. The expected outcome is to eliminate a dangerous human risk and, finally, the proposed research could reduce virus spread. Significant change by implementing innovation in healthcare sector development, ensuring a healthy and safe environment for healthcare workers as well.
Keywords- robotic; pandemic prevention, healthcare application, smart system

INTRODUCTION

Automation robotics in the healthcare sector may certainly improve the clinical process that could have a harmful effect towards human and environment. When working with robots, decreased exposure to radiation, increased reliability and cost savings are all potential benefits of clinical waste management facilities, whether for collecting, transporting and waste disposing. This is the fundamental aspect that can be studied in this robot is the arrangement of the system, such as the handling configuration, joint limits and disinfection mechanism respectively for disposing the hazardous waste with spraying mechanism. For the design, the robot base can be modified to carry different containers. Chemical disinfection equipment or lights can also be placed on a robotic base. In addition, the safety element will include the line tracking system and the spray module to protect the environment. There is a need for continuous cleaning and disposal due to Corona virus. It is becoming more and more difficult for waste collection activities to take place as waste management workers are expected to stay at home to take care of their family or self-isolation. This takes a lot of effort and therefore concentrates on the most critical areas: surgery, toilets, and patient rooms. The current disposal process is being carried out manually by humans, therefore it

is recommended that an automated disposal process be carried out. The importance of developing such a system makes it possible to carry out operations more safely in difficult environments. Potential increases in speed, safety and economic advantages are the driving forces behind such an application. In addition, cleaning and disinfection activities in hospitals and institutions are carried out manually and some areas need to be sanitized after every use (for example, when the room is cleaned and prepared for the next patient). This poses obvious health risks, especially during a pandemic, and human error can occur. Manual disinfection carries the risk of spreading rather than cleaning the contaminated surface. Indeed, the need to automate the process is of paramount importance in ensuring the safety and health of workers. The study of the technology for automation for the management and disposal of clinical waste earned considerable attention in the literature. To the best of author's knowledge, the study of robotic applications to simultaneously perform hazardous tasks of collecting, transporting, and disinfecting the area during COVD-19 remains limited in waste management. On the basis of literature, the existing robotic application usually performs work separately. There is therefore a gap to accomplish the task at the same time by enhancing the robot capabilities. To summarised, the most important highlights of robot assistant to perform the waste disposal management including collection, cleaning, disposal, and disinfection for healthcare sector is deemed important. Literatures search demonstrated that the specific application to handle clinical waste in hospital has still limited. The robotic technology can be seen able to uplift the purpose of robotic automation instead of manual routine work for target area therefore offer advantage of alleviating human resources. With no human presence, this means that also powerful/concentrated disinfectant can be used when cleaning the clinical waste. No need for large-volume soap and water mixtures, as a small amount of disinfectant vapour is released in the surface and dries within minutes.

METHODOLOGY

The handling of clinical waste is a challenging and high-risk activity that may impact the worker ‘s health. This medical support robot is essential to reduce the harmful effect of clinical waste, particularly waste that can easily spread as this disease is mainly transmitted from indicative people to those who are in close contact through respiratory droplets, through direct contact with infected people, or contact with contaminated objects and surfaces. This robot consists of an auto-tracking navigation system, a smart charging power supply system, and actuator system for this medical assist. Since the device is designed to operate at a high-risk location, the robot is designed with safety requirements that include proper circuit and main controller device waterproof protection. The system is designed with a smart power supply system that included a 12V smart charger, a 12V high-capacity lead-acid battery, and a low-voltage converter to retain the robot functionality. The smart power supply system will ensure that the power storage will provide sufficient supply to the entire device to operate at the optimum voltage and current. The robot is installed with a sensory system consisting of multiple sensors to navigate the robot through the designed pathway which is the navigation tracking sensor and the obstacle avoidance sensor surrounding it. The tracking sensor will sense the planned pathway that was constructed on the pathway for the handling of clinical waste. The surround avoidance sensor is used to detect any object or obstacle that may intervene in robot navigation. The full block diagram architecture of the system mentioned is shown as in **Figure 1**. Since the robot handles the clinical waste that could spread the disease unintentionally, the robot platform is designed to be equipped with a disinfection platform that could disinfect the robot as well as the clinical waste compartment and clinical waste region. The disinfecting platform actuator is mounted on the robot, utilizing a high-pressure pump, mist sprinkler, and storage tank sanitizer. Therefore, the disease spread will be lowered with this

self-sanitizing equipment that integrates on the system. And **Figure 2** shows the system's conceptual design of the disinfection platform.

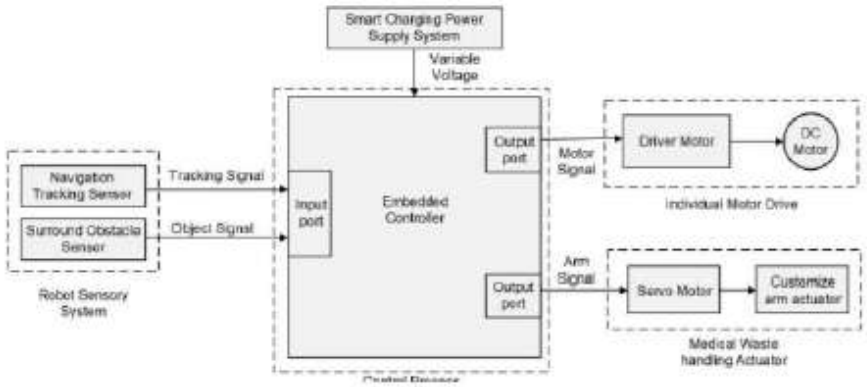

Figure 1 Block diagram of SR for assisting in managing the clinical waste

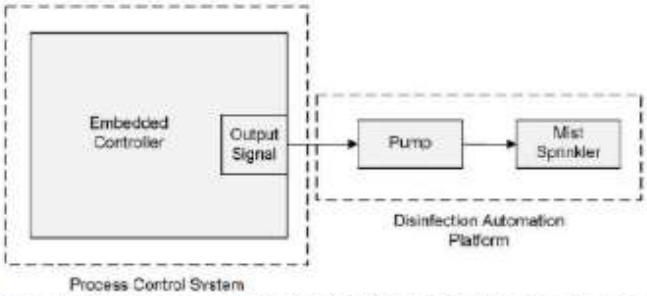

Figure 2 Block diagram of disinfection platform in managing the clinical waste

RESULT AND DISCUSSION

Figure 3 demonstrates the implementation and conceptual design of the SR hardware, which consists of two main parts, the smart maneuverer section, and the disinfection section. The first section contains robotic design which accepts input from obstacle sensor and tracking sensor. As the robot moves to follow the designated route, the sensors continuously read the route until reaches the destination location. Then the handling actuator perform it function to collect the clinical waste and keep in safe waster compartment. This action was then followed by second section to conduct disinfection process in which the pump and mist sprinkler were further activated. The process completed and the SR returned to original location.

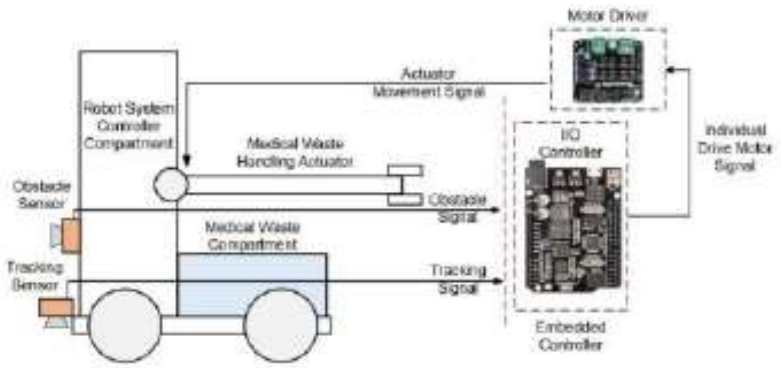

Figure 3 Actual illustration for hardware implementation

CONCLUSION

The proposed conceptual framework by contributing in the form of an unmanned smart robotic system for the automated waste handling and disinfecting. The outcome of the study is significant in terms of making a technical contribution to the non-contact application against the COVID-19 virus spread in healthcare sector and thus ensure safe and sustainable workplace for healthcare workers. The propose research is also important for protecting human from the Corona outbreak. By automating the waste management process and disinfecting purposes (vapour disinfection), this will avoid the harmful risk towards human and finally the proposed work could alleviate the virus from being transmitted. Therefore, with the implementation of automation robotic in healthcare industry would minimise the harmful impact towards human health. This result will protect the worker for long term run, so that would not impose high risk to the workers and ultimately would minimise the hospitalisation bill that will burden the government.

ACKNOWLEDGMENT

The author wishes to express her gratitude to Universiti Teknologi Mara (UiTM) for the support provided in this work.

REFERENCES

[1] J. M. Boyce, ―A Review of Wipes Used to Disinfect Hard Surfaces in Healthcare Facilities,‖American journal of infection control. 2020.

[2] M. B. Quemelli and A. S. Brandão, ―Handling and pushing objects using unmanned guided vehicles,‖Robot. Comput. Integr. Manuf., 2020. [3] G. Z. Yang et al., ―Combating COVID-19-The role of robotics in managing public health and infectious diseases,‖Science Robotics. 2020.

[3] N. Zheng and X. Gao, ―Research and design of the cleaning and disinfecting vehicle,‖ in Proceedings - 2020 International Conference on Computer Engineering and Application, ICCEA 2020, 2020.

[4] R. Parween, M. V. Heredia, M. Rayguru, R. E. Abdulkader, and M. R. Elara, ―Autonomous Self-reconfigurable Floor cleaning Robot,‖IEEE Access, 2020.

[5] S. Kong, M. Tian, C. Qiu, Z. Wu, and J. Yu, ―IWSCR: An Intelligent Water Surface Cleaner Robot for Collecting Floating Garbage, ‖IEEE Trans. Syst. Man, Cybern. Syst., 2020.

[6] Y. Bai, S. Yang, Y. Wu, Y. Chen, S. Pan, and Y. Deng, ―Expansible Surface Waste Cleaning Robot, ‖ 2020. [8] L. D. Riek, ―Healthcare robotics, ‖ Communications of the ACM. 2017.

[7] L. Shao et al., ―EEG-Controlled Wall-Crawling Cleaning Robot Using SSVEP-Based Brain-Computer Interface, ‖ J. Healthy. Eng., 2020.

[8] R. Vishaal, P. Raghavan, R. Rajesh, S. Michael, and M. R. Elara, ―Design of Dual-Purpose Cleaning Robot, ‖ in Procedia Computer Science, 2018.
[9] I. P. G. Riaan, I. N. S. Kumara, C. G. I. Partha, I. N. Setiawan, and D. A. S. Sanitary, ―Robot for Cleaning Solar PV Module to Support Rooftop PV Development, ‖ in 2018 International Conference on Smart Green Technology in Electrical and Information Systems: Smart Green Technology for Sustainable Living, ICSGTEIS 2018 - Proceeding, 2018.