INDONESIAN JOURNAL OF ENGINEERING RESEARCH
2021, Vol. 2, No. 1, 1 – 6
http://dx.doi.org/10.11594/ijer.02.01.01

Research Article

3in1 Robot Design for Medical Assistant on 2019-nCoV case

Syamsiar Kautsar[1]*, Robby Ardiansyah[1], Muhammad Mashfuks[2], Khafidurrohman Agustianto[3]

[1] Mechatronics Engineering, Politeknik Negeri Jember, 68121, Indonesia
[2] Computer Engineering, Politeknik Negeri Jember, 68121, Indonesia
[3] Informatics Engineering, Politeknik Negeri Jember, 68121, Indonesia

Article history:
Submission February 2021
Revised April 2021
Accepted April 2021

**Corresponding author:*
E-mail:
syamsiar_kautsar@polije.ac.id

ABSTRACT

Covid-19 (Coronavirus disease 2019) is a new coronavirus (SARS-CoV-2) that is known to have originated in Wuhan, China. It was found at the end of December 2019 with countries infected with the Coronavirus in more than 65 countries. According to WHO data as of the 4th of March 2020, the number of sufferers was 90,308 infected with Covid-19. In Indonesia as of April 14, 2010, people with Covid-19 were positive for 4,839, recovered 426, and died 459. In Indonesia, one of the ways to tackle the Covid-19 pandemic is by spraying with disinfectant liquid and delivering food or medicine to patients infected with Covid. -19 is still in close contact with a patient who is still likely to be infected from that patient. According to general guidelines in dealing with the Covid-19 pandemic, one of them is done by spraying disinfectants in several public facilities such as health clinics, government office, schools, bridges, parks, fields, and other public areas. However, sterilization is still done manually by health workers. This puts medical personnel at risk of being exposed to the covid-19 virus. Therefore, in this study, a multi-functional robot with a remote control equipped with an FPV camera was developed. The robot can be used to spray disinfectant, UV lamp-based sterilization, and deliver food and medicine to patients infected with Covid-19. From the test results, the teleoperation system can work well with a range of 30 meters indoors and 150 meters outdoors.

Keywords: Tricycle drive, robot, teleoperation, telemetry, 2019-nCoV

Introduction

In early 2020, Chinese authorities announced that there was an outbreak of a disease that attacks respiratory function. The epidemic caught the world's attention after in January 2020, health authorities in Wuhan City, Hubei Province, China, said there were patients who died after suffering from pneumonia caused by the virus [1]. The new type of coronavirus that is currently attacking the world

How to cite:
Kautsar, S., Ardiansyah, R., Mashfuks, M., & Agustianto, K. (2021). 3in1 Robot Design for Medical Assistant on 2019-nCoV case. *Indonesian Journal of Engineering Research*, *2*(1), 1 – 6. doi: 10.11594/ijer.02.01.01

community at this time in medical terms is referred to as 2019 Novel Coronavirus (2019-nCoV) [2] [3].

The disease outbreak caused by the 2019-nCoV virus is growing so rapidly that WHO has categorized this outbreak as a pandemic [4]. In Indonesia, as of 24 March 2020 there were 686 patients who tested positive for the 2019-nCoV virus with 55 cases dying [5]. This made the government extend the disaster period of the Coronavirus outbreak until the end of May 2020 [6].

Coronaviruses have capsules, particles of a spherical or elliptic shape, often pleiomorphic with a diameter of about 50-200m. All viruses of the order Nidovirales are capsule, unsegmented, and RNA positive viruses and have very long RNA genomes. The structure of the coronavirus forms a tube-like structure with the S protein located on the surface of the virus. Protein S or spike protein is one of the main antigen proteins of viruses and is the main structure for writing genes. This protein S plays a role in the attachment and entry of the virus into the host cell (the interaction of S protein with its receptors in the host cell) [6]. Coronaviruses are sensitive to heat and can be effectively inactivated by disinfectants containing chlorine, lipid solvents with a temperature of 56 ℃ for 30 minutes, ether, alcohol, peroxyacetic acid, non-ionic detergents, formalin, oxidizing agents, and chloroform. Chlorhexidine is not effective in deactivating viruses.

According to general guidelines in dealing with the Covid-19 pandemic, one of them is done by spraying disinfectants in several facilities such as health clinics, village offices, schools, bridges, parks, fields, and other public areas [7]. In the spraying, it is done manually by health workers. This can potentially have a negative impact on health workers due to exposure to disinfectant drugs and recorded patients. Therefore, in this study, a robot was developed that could be used to assist medical personnel in carrying out their duties. This robot can be controlled remotely using a remote control. The robot is also equipped with an FPV camera to provide a visual view of the work environment. The results of this research are expected to make a positive contribution to the prevention of the Covid-19 outbreak.

Methods

The robot is designed with a tricycle drive system [8] [9]. The front of the robot is moved using 2 PG36 motors coupled with 15 cm diameter wheels. The back of the robot is driven by a wheel coupled with a standard servo motor with a torque of 25kg.cm. The rear wheel is used as a robotic steering system. The robot design is shown in figure 1. The robot is designed to be used in work areas that are not always flat.

In order to be controlled remotely [10] [11], the robotic teleoperation system uses an R / C remote with a frequency of 2.4GHz. This remote has a working range of 1 KM outdoor. An STM32 microcontroller is used to read the PWM signal from the remote receiver. To facilitate remote operation, the robot is also equipped with a 5MP Eachine TX06 700TVL type FPV camera. This camera can transmit image data that can be seen on the user's smartphone screen.

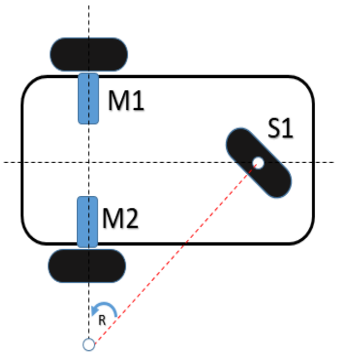

Figure 1. Robot drive system

Hardware

The 12 volt 2 Ampere motor sprayer is used to spray disinfectant liquid. The end of the motor is connected to an 8 mm misting nozzle sprayer. The type of sprayer used can produce mist to optimize the dispersion of the disinfectant liquid. The tip of the sprayer is attached to a slider to adjust the sprayer height. In addition, the robot is also equipped with a 9 Watt UV-C lamp. Since the UV-C lamp uses an AC power supply, a 150-watt inverter is used to convert the 12 VDC to 220VAC battery voltage.

Figure 2 is a system block diagram of the robot. The overall control of the robot is carried out by the STM32F103C8T6 microcontroller. The BTS7960 motor driver is used to control the direction and speed of the motor using PWM output pulses. Meanwhile, the activation of pump motors and UV lamps uses a relay that functions as a digital switch.

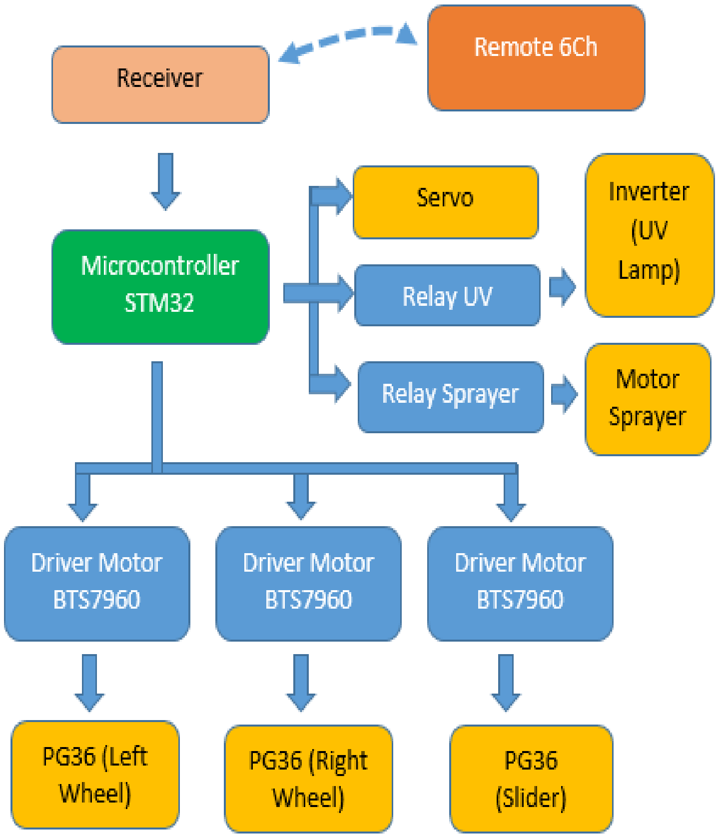

Figure 2. Block diagram system

Sofware

The control system on the robot uses a 2.4GHz 6 channel RC remote. In this case, the microcontroller will read the pulse data on the receiver. There are 5 pulse data read. The pulse data is then processed into motor rotating speed, steering servo working angle, slider motor rotation direction, and relays for pump motors and UV lamps. Figure 3 is a mapping of remote pulses read by the microcontroller.

Channel1 (a) is used as the data speed and direction of the PG36 motor rotation. Channel2 (b) is used as the servo working angle data. Channel3 (c) is used for sliders. Channel4 (d) and channel5 (e) were used for activation of the sprayer motor and UV lamp, respectively.

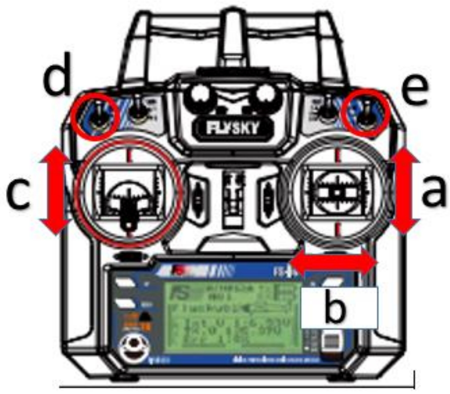

Figure 3. Remote channel mapping

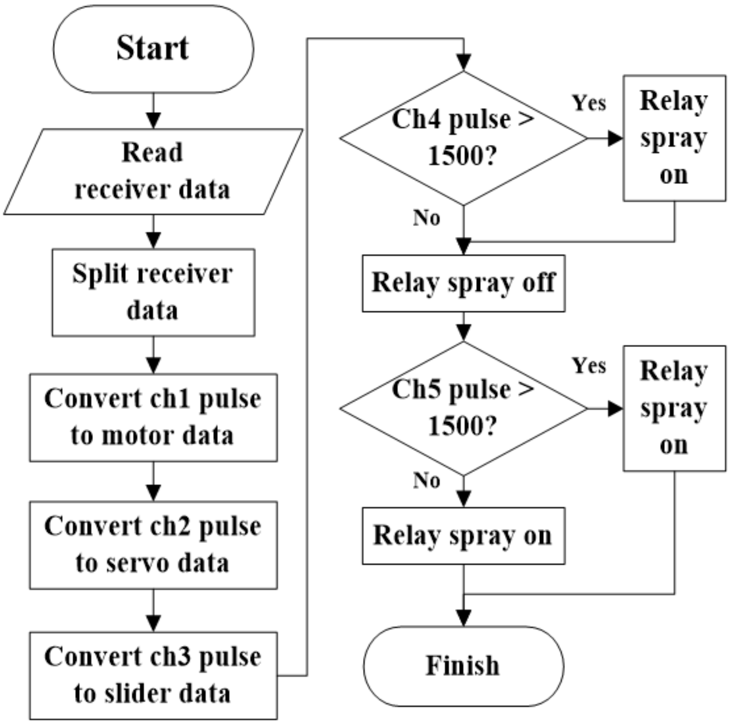

Figure 4. Flowchart system

The programming flowchart on the robot is described in Figure 4. First, the microcontroller will read data from the receiver. Furthermore, the data will be split into 5 variables. The first and third variables are then processed into the PWM value and direction for the BTS7960 motor driver. The second variable is processed into the pulse value for the servo. The 4th and 5th variables are processed into digital logic to activate the relay. The whole process is carried out in a loop at a microcontroller speed of 8MHz.

Results and Discussions

The robot dimension is 80 cm x 60 cm. The robot body uses ACP to be light and strong. A water reservoir with a capacity of 20L is installed inside the robot to accommodate disinfectant liquid. The choice of wheelchair type is intended so that the robot can be operated on various floor conditions. Figure 5 is the result of the robot realization. General radio transmitter and FPV glasses are used to provide comfort and convenience to operators for controlling the robot.

Figure 5. Realization of robot design

$$PWM = \frac{pulse - 1500}{500} . 255 \text{ ....1)}$$

Equation (1) is used to convert remote pulses to motor rotational speed. Equation 1 is used to obtain the output direction and speed of the motor in accordance with the range of values given by the user. Some of the tests were carried out directly both indoors and outdoors. Figure 6 is the route used for testing. The furthest distance outdoors is 75 meters and the robot can still be controlled properly. Table 1 is the test result data at both indoor and outdoor locations.

Figure 6. Outdoor robot system test

In addition, the function testing of the robot is also carried out, namely sterilizing the room using disinfectant fluids and UV lamps. Figure 7 is a test of the sprayer and UV lamp attached to the robot. As shown in the photo the robot can spray disinfectant well. UV lamps are used to sterilize parts of the floor that may not be reached by spraying a disinfectant.

Figure 7. Sterilization feature testing

Table 1. Data Testing

No.	Condition Test	Length (meters)	Result
		Indoor	
1.	FPV, spray, manuever, UV	10	All Work
2.	FPV, spray, manuever, UV	20	All Work
3.	FPV, spray, manuever, UV	30	All Work
4.	FPV, spray, manuever, UV	40	Camera not view
		Outdoor	
1.	FPV, spray, manuever	50	All Work
2.	FPV, spray, manuever	75	All Work
3.	FPV, spray, manuever	100	All Work
4.	FPV, spray, manuever	130	All Work
5.	FPV, spray, manuever	140	Camera not view

Based on the direct testing phase in the field, the robot can run without any interference. The tricycle drive system for maneuvering works well. The robot has also been tested with sloping and bumpy floor conditions. The slope of the test floor is 20 degrees. Testing of the roaming distance of the robot in the room with any obstacles, the results obtained with a maximum teleoperation distance of 30 meters with visual conditions can be received well through the video sender on the FPV viewer application.

Conclusion

From the test results, it can be concluded that the robot can work well, the teleoperation system on the robot can work well with a maximum range of 30 meters in the building, and a maximum range of 130 meters outside the building.

Acknowledgement

Thank you to the Jember State Polytechnic for facilitating the development of this 3in1 covid-19 robot. Thank you also to the Jember district government for using this robot to deal with the covid-19 outbreak.

References

1. https://www.aljazeera.com/news/2020/01/clone ofchina-battles-coronavirus-outbreak-latest-200124234326882.html
2. WHO (2019) Novel Coronavirus (2019-nCoV) Situation Report - 10, reported 30 January 2020
3. Read JM et al. (2019) Novel coronavirus 2019-nCoV: early estimation of epidemiological parameters and epidemic predictions. medRxiv. .https://doi.org/10.1101/2020.01.23.20018549
4. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020,
5. http://sehatnegeriku.kemkes.go.id/baca/rilis-media/20200324/0033496/update-kasus-corona-24-maret-686-konfirmasi-positif/,
6. PDPI. (2020). Pnemonia Covid-19. Diagnosis & Penatalaksanaan di Indonesia.
7. Tim Kerja Kementerian Dalam Negeri. (2013). Pedoman Umum Menghadapi Pandemi Covid-19 Bagi Pemerintah Daerah : Pencegahan, Pengendalian, Diagnosis dan Manajemen.
8. Widiawan, B., Triwidiarto, C., Kautsar, S., & Firgiyanto, R. (2020). Wireless Greenhouse Monitoring System Using Tricycle Mobile-Robot Based On Rasberry PI. IOP Conference Series: Earth and Environmental Science, 411, 012058. doi:10.1088/1755-1315/411/1/012058.
9. F. Tanaka and T. Takahashi, (2012) "A tricycle-style teleoperational interface that remotely controls a robot for classroom children," 7th ACM/IEEE International Conference on Human-Robot Interaction (HRI), Boston, MA, 2012, pp. 255-256.
10. J. Kofman, Xianghai Wu, T. J. Luu and S. Verma, (2005) "Teleoperation of a robot manipulator using a vision-based human-robot interface," in IEEE Transactions on Industrial Electronics, vol. 52, no. 5, pp. 1206-1219.
11. Yuji Kimitsuka, Tsuyoshi Suzuki and Kei Sawai, (2008) "Development of mobile robot teleoperation system utilizing Robot Sensor Network," 5th International Conference on Networked Sensing Systems, Kanazawa, pp. 250-250.