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DEVELOPMENT OF DISINFECTION ROBOT FOR HANDLING SPREADING OF COVID-19 IN INDONESIA

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Abstract. *The novel respiratory illness of Coronavirus disease 2019 (COVID-19) is coming to us at an exponential speed: gradually, and then suddenly. It has spread to 160 countries and until March 31, 2020, infected more than 750,890 cases with 36,405 deaths (CFR 4.85%). Whereas Indonesia, with 1,528 cases and 136 deaths, had a CFR of 7.98%, which is a terrible country concern. In this paper, we propose a disinfection robot named as Nayakalara, which can be controller wireless using Mobile Apps and Bluetooth technology or in autonomous mode using 3 distance sensors. 12V pump is used for spraying the disinfectant with the range maximum about 2.5 meters. This is an alternative solution for spraying disinfectant remotely. We show the framework and analyze the experimental result.*
Keywords: Disinfection robot, COVID-19, Pump, Bluetooth, CFR

1. **Introduction.** Starting from Hubei province in China, COVID-19 has been spreading all over the world, after two months of outbreak in China. The symptoms of COVID-19 include fever, coughing, and difficult breathing. Person-to-person spread of the virus is thought to occur mainly through respiratory droplets produced when an infected person coughs or sneezes, like how the flu spreads. As the global human population grows and continues to interact with animals, other opportunities for viruses that originate in animals (like COVID-19) could make the jump from humans and spread. The CDC (Centers for Disease Control and Prevention) estimates that three out of four new diseases in humans come from animals, and scientists believe there are approximately 800,000 unknown animal viruses that could infect humans [1]. The ongoing outbreak of COVID-19, has claimed 191,127 confirmed cases and 80,928 positive cases and 3,245 death in China, as of 19 March 2020. The coronavirus pandemic is killing mostly older adults with underlying health conditions. The last pandemic was the 2009 swine flu, caused by the H1N1 virus. That pandemic, which was first detected in Mexico, killed an estimated 200,000 people and hit young adults and children hardest [2,3].

In Indonesia, total confirmed cases are 1,528 with 136 deaths [3,5]. Indonesia, with a population of around 270 million, experiences slower COVID-19 cases compared to other countries, and unfortunately the Government is taking a late and slow response. Indonesia should be more serious for handling the COVID-19. After 2 citizens died in Indonesia, President Jokowi said more serious attempts are needed to combat the COVID-19 disease that has been declared a pandemic by the World Health Organization. In Indonesia, despite mounting evidence to the contrary, security minister Mohammad Mahfud MD has told reporters "the coronavirus does not exist" in the country. Indonesia's health officials insist their protocols follow the World Health Organization's guidelines with a

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system focusing on temperature checks at arrival gates and self-reporting. Most of Southeast Asia follows this approach, even as several studies indicate border screenings are not effective [4]. Effort of Indonesian government for handling and inform updated COVID-19 using "Gugus Tugas COVID-19".

There are some researchers developing disinfection robot specially for COVID-19; for example, Danish disinfection robots save lives in the fight against the Corona virus [10]. The Connor UVC Disinfection Robot is designed for indoor virus prevention. It is equipped with cutting-edge technology including UV sterilization lamps and an automatic disinfectant spray module. It is currently used to fight against Coronavirus (COVID-19) [11]. Ultraviolet-C (UV-C) disinfection is one type of no-touch technology shown to be a successful adjunct to manual cleaning in reducing environmental bioburden [12]. Unfortunately, still the problem is the cost of the robot very expensive and the technology so advanced, so it cannot be used in developing country. In this paper we propose a prototype of disinfection robot as shown in Figure 1. The novelty of this system is a simple navigation and controller based on smartphone. The organization of the paper consists of introduction, related works, proposed method and experimental results and discussion.

FIGURE 1. We named the robot as Nayakalara, and it uses Smartphone apps for navigating the robot, water pump and controlled using Arduino and Bluetooth module HC-05 for disinfection robot.

2. **Coronavirus COVID-19.**

2.1. **Spreading of COVID-19.** Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). The disease started in 2019 in Wuhan, China, and has spread globally, resulting in the 2019-20 coronavirus pandemic [5]. Symptoms that may indicate exposure to COVID-19 are such as cough, fever, muscle aches, shortness of breath and sore throat. The coronavirus is shown in Figure 2.

Table 1 shows the emergency situation of Republic of Indonesia that has many problem for solving the COVID-19.

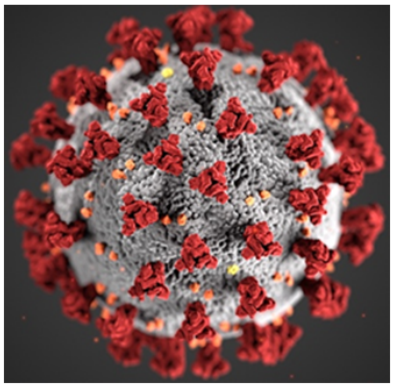

FIGURE 2. Coronavirus COVID-19 [1]

TABLE 1. Accumulation of COVID-19 by province in Indonesia

No	**Province**	**Accumulation (31 March 2020: 1,528, 136 death, 81 recovered)**											
		March											
		20	21	22	23	24	25	26	27	28	29	30	31
1	Aceh	0	0	0	0	0	0	1	4	4	5	5	5
2	Bali	3	3	3	6	6	9	9	9	9	10	19	19
3	Banten	39	43	47	56	65	67	67	84	103	106	128	142
4	Bangka Belitung	0	0	0	0	0	0	0	0	0	0	1	2
5	DI Yogyakarta	4	5	5	5	6	16	16	22	22	17	18	23
6	DKI Jakarta	223	267	307	354	424	462	515	598	627	674	698	747
7	Jambi	0	0	0	1	1	1	1	1	1	1	2	2
8	Jawa Barat	41	55	59	59	60	73	78	98	119	155	180	198
9	Jawa Tengah	12	14	15	15	19	38	40	43	55	64	81	93
10	Jawa Timur	15	26	41	41	51	51	59	66	77	90	91	93
11	Kalimantan Barat	2	2	2	2	3	3	3	3	3	8	9	9
12	Kalimantan Timur	9	9	9	11	11	11	11	11	17	17	17	20
13	Kalimantan Tengah	2	2	2	2	3	4	6	6	7	7	7	9
14	Kalimantan Selatan	0	0	1	1	1	1	1	6	1	1	5	8
15	Kalimantan Utara	0	0	0	0	0	0	0	0	2	2	2	2
16	Kepulauan Riau	4	4	4	5	5	5	5	5	5	5	6	7
17	Nusa Tenggara Barat	0	0	0	0	1	2	2	2	2	2	2	4
18	Sumatera Selatan	0	0	0	0	1	1	1	1	2	2	2	5
19	Sumatera Barat	0	0	0	0	0	0	3	5	5	5	8	8
20	Sulawesi Utara	1	1	1	1	2	2	2	2	2	2	2	2
21	Sumatera Utara	2	2	2	2	7	8	8	8	8	8	13	19
22	Sulawesi Tenggara	3	3	3	3	3	3	3	3	3	3	3	3
23	Sulawesi Selatan	0	2	2	4	4	13	27	29	33	46	50	50
24	Sulawesi Tengah	0	0	0	0	0	0	1	1	2	3	3	3
25	Lampung	1	1	1	1	1	1	3	4	4	4	8	8
26	Riau	1	1	1	1	2	1	2	1	1	2	3	3
27	Maluku Utara	0	0	0	1	1	1	1	1	1	1	1	1
28	Maluku	0	0	1	1	1	1	1	1	1	1	1	1
29	Papua Barat	0	0	0	0	0	0	0	2	2	2	2	2
30	Papua	0	0	2	2	3	3	7	7	7	9	9	10
31	Sulawesi Barat	0	0	0	0	0	0	0	0	0	1	1	1
32	Bengkuku	0	0	0	0	0	0	0	0	0	0	0	1
Prepared by Widodo Budiharto													
(source: www.detik.com and BNPB RI)													

2.2. **Bluetooth technology.** Robot in a military context is a powered machine that 1) senses, 2) thinks (in a deliberative, non-mechanical sense), and 3) acts. Although various attempts to create controlled machines were made throughout history, the first fully-controlled one was invented by Nikola Tesla in 1898. It was a radio-controlled boat, which he believed could be used for military purposes. However, his idea was rejected [6].

Wireless technology such as Bluetooth can be used for controlling devices. One of the most popular modules for research is HC-05. HC-05 is used for many applications like a wireless headset, game controllers, wireless mouse, wireless keyboard and many more consumer applications. It has range up to < 100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is IEEE 802.15.1 standardized protocol, through which one can build a wireless Personal Area Network (PAN). It uses Frequency-Hopping Spread Spectrum (FHSS) radio technology to send data over the air. This module can be used in a master or slave configuration. Figure 3 can be seen HC-05 Bluetooth module used in prototype development.

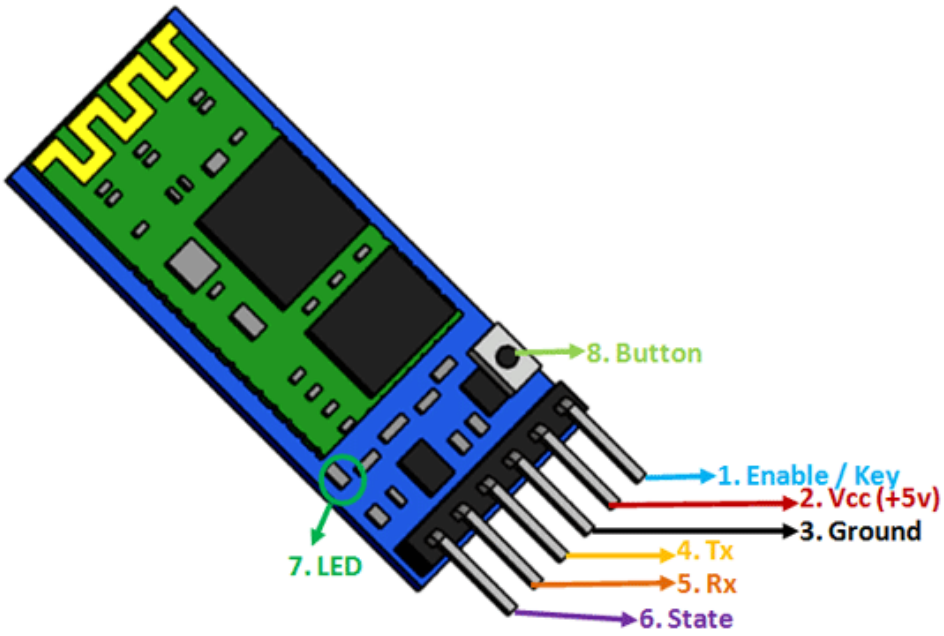

FIGURE 3. HC-05 Bluetooth module [7]

3. **Proposed Method.** Many methods are proposed by scientist for controlling the robot using Bluetooth or autonomous by obstacle avoidance. The authors have conducted prior research for controlling robot using Bluetooth technology and ultrasonic sensor [8,9]. We use high voltage 24V and current 7A for the DC Motor and drivers of the robot able to move with enough power. The Bluetooth module will be used for accepting commands from Android HP and App Inventor as shown in Figure 4. We use a relay to activate the 12V pump sprayer.

First, the program will make a connection between the smartphone and the robot using Bluetooth protocol. The algorithm of disinfection robot and controlling using Bluetooth is shown in Algorithm 1.

4. **Experimental Result.** We developed a program for controlling the microcontroller using Ardunio. We use App Inventor for developing Android Apps for controlling remotely. The security system of Bluetooth technology is very good. First, we should click the connect button from apps and choose the correct identifier of Bluetooth from the robot.

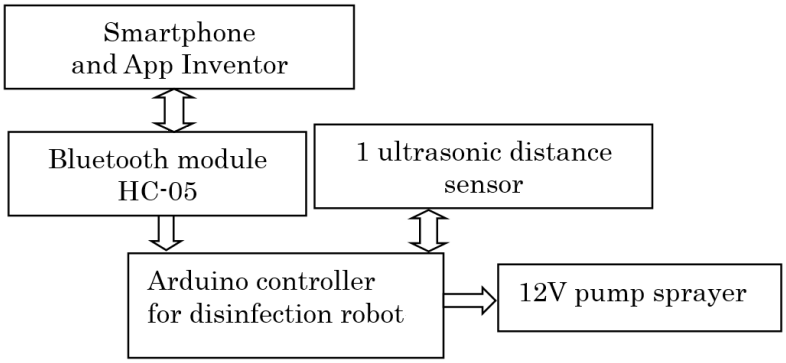

FIGURE 4. The architecture of an autonomous disinfection robot

Algorithm 1. Autonomous disinfectant robot and controlling using Bluetooth

```
Declare variables
Begin
Sprayer active
if Bluetooth connected, then
   Open connection
Accepting input with 9600bps
Switch case (input)
   if user click spray then
            Sprayer active
   end if
   if user click forward then
            Move forward
            Sprayer active
   end if
   if user click left then
            Move left
            Sprayer active
   end if
   if user click right then
            Move right
            Sprayer active
   end if
end if
if Bluetooth disconnected, then
   close connection
end if
End
```

We use function such as touch down and touch up from App Inventor, so navigation of the robot easier. The application built using App Inventor is shown in Figure 5.

Based on the experiment, the ability of pump to spray the disinfectant is enough with maximum 2.5 meters. Table 2 shows the experimental results with good performance.

With 3 distance sensors, robot is also able to spray and avoid obstacle in front of the robot.

5. **Conclusions.** In this paper, we propose a model of disinfection using Arduino controller and smartphone application with a focus on spraying COVID-19 using 12V pump

FIGURE 5. Result of the Android App using App Inventor. We should scan the Bluetooth first, and then we can control the robot using navigation button. Spray button for spraying the disinfectant and stop for stopping the sprayer.

TABLE 2. Experimental results for controlling a robot for distance 4 meter

No	Results from 10 times simulation		
	Action	***Success***	***Not success***
1	Move forward	9	1
2	Move right and left	9	1
3	Stop	9	1
4	Spray the object	10	0

and controlled using Bluetooth and 1 distance sensors. The experimental results with good performance are able to control the robot with distance 10 meters. A disinfection robot is an important tool for combating this pandemic. As a suggestion, physical distancing and lockdown must be carried out immediately by the Indonesian government.

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