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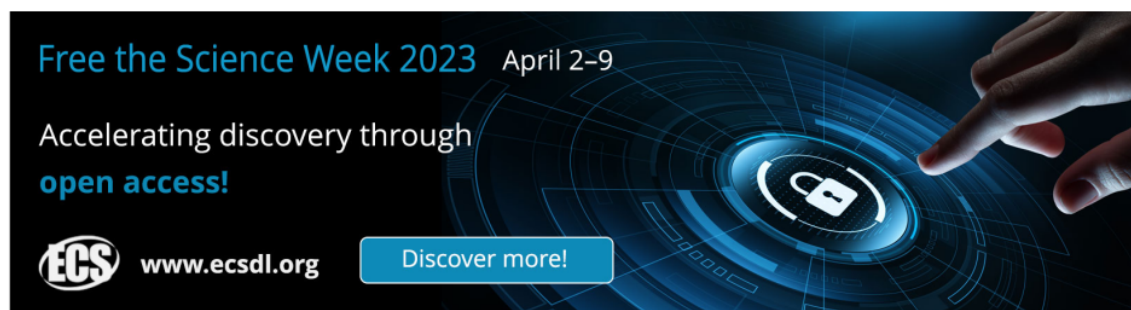To cite this article: P Destarianto *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **672** 012047

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Development of integrated swab chamber for drive thru Covid19 test system

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Abstract. WHO currently recommends molecular testing for all patients who are included in the suspect category. The molecular examination requires facilities with biosafety level 2 (BSL-2), meanwhile for culture testing at least BSL-3. Viral culture is not recommended for routine diagnosis. The recommended method for virus detection is nucleic acid amplification by real-time reverse-transcription polymerase chain reaction (rRTPCR) and by sequencing. The sample is said to be positive (confirm SARS-CoV-2) if the RRT-PCR is positive for at least two genomic targets (N, E, S, or RdRP) that are SARSCoV-2 specific; OR positive RRT-PCR for betacoronavirus, supported by sequencing results of part or all of the viral genome according to SARS-CoV-2. To reduce the spread of the virus, the government began to carry out massive swab tests. Molecular rapid tests are easier to perform and faster because the process is automated which greatly helps speed up detection. To support a safe swab process, in this study an integrated portable swab booth was built. The output of this research is expected to contribute to the prevention of the spread of disease caused by the 2019-nCoV virus.

1. Introduction

Initially, the disease was temporarily named as 2019 novel coronavirus (2019-nCoV), then WHO announced a new name on February 11, 2020, namely Coronavirus Disease (COVID-19) which [2] was caused by the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-) virus. CoV-2) [3] This virus can be transmitted from person to person and has spread widely in China and more than 190 other countries and territories. On 12 March 2020, WHO declared COVID-19 a pandemic. As of March 29, 2020, there were 634,835 cases and 33,106 deaths worldwide. Meanwhile in Indonesia, as of May 30, 2020, 25,773 positive cases of COVID-19 and 1,573 deaths have been confirmed [4].

WHO currently recommends molecular testing for all patients who are included in the suspect category. Examination of individuals who do not meet the criteria for suspicion or asymptomatically may also be done by considering epidemiological aspects, local screening protocols, and availability of equipment. The molecular examination requires facilities with biosafety level 2 (BSL-2), while for culture at least BSL-3. Viral culture is not recommended for routine diagnosis. The method recommended for virus detection is nucleic acid amplification by real-time reverse-transcription polymerase chain reaction (rRTPCR) [5] and by sequencing. The sample is said to be positive (confirm SARS-CoV-2) [6] if RRT-PCR is positive for at least two genome targets (N, E, S, or RdRP) that are SARSCoV-2 specific; OR positive RRT-PCR for betacoronavirus, supported by sequencing results of

part or all of the viral genome according to SARS-CoV-2. Unlike the WHO, the CDC itself currently only uses primers N and RP for molecular diagnosis. The US Food and Drug Administration (FDA) has also approved the use of a GenXpert® based molecular rapid test named Xpert® Xpress SARS-CoV-2 [7]. Other companies are also developing similar technology. Molecular rapid tests are easier to perform and faster because the process is automated which greatly helps speed up detection.

Based on the massive inspection conducted by the government [8], in this study, an integrated portable swab booth was developed. The booth is made of a stainless plate so that medical personnel is safe from the risk of exposure to the Covid-19 virus from patients. The interior of the chamber is equipped with an air purification system to maintain air quality for medical personnel. The booth is also equipped with a fan exhaust system to keep air circulating in the chamber. The front of the chamber is designed with acrylic and gloves for virus sampling. There are machines for sterilizing gloves based on disinfectants and UV lamps [9]. The booth is designed to be used in various field conditions so that it can help medical personnel to check in various locations safely. The output of this research is expected to contribute to the prevention of the spread of disease caused by the 2019-nCoV virus. January 25, 2020, a total of 1975 cases have been confirmed nationally with another 2684 cases suspected to be caused by Covid-19 [9]. On January 31, the first 2 cases of a novel coronavirus in the UK, [10] the first 2 cases in Russia, [11], and the first cases in Sweden and in Spain were reported. Canada reports the 4th case. The case in Indonesia itself was first discovered on March 1, 2020, while currently, the cases found in Indonesia have reached 893 [12]. Looking at the cases that have emerged, WHO equates prevention/suppression of the number of sufferers with Middle-East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS), human-to-human transmission occurs through droplets, contact, and fomites (sources of infection from inanimate objects) [1].

2. Material and methods
2.1 Hardware Design
For learning, a wireless microphone device is needed that is used with a face shield. Face shield made with 3D printer technology. The design of the face shield device is shown in Figure 1. The UV-based sterilization device uses a UV-C lamp with a capacity of 38 Watts. The UV lamp is placed in a 60cm x 60cm booth made of polycarbonate material. The teaching device that will be sterilized is simply put on the inside of the room.
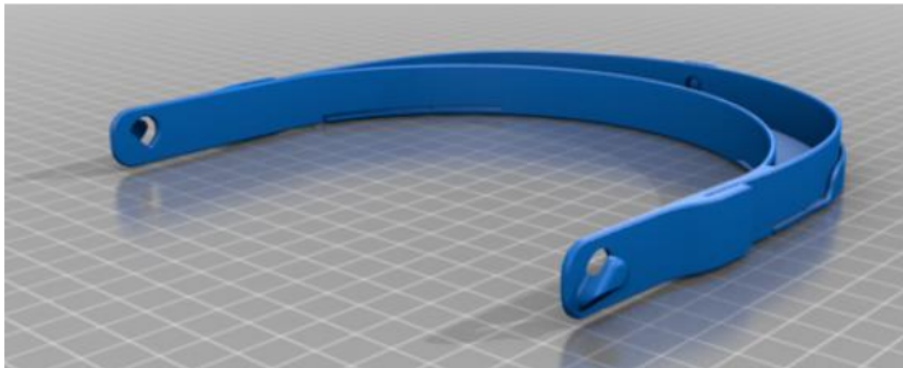
Figure 1. Hardware design

Figure 2. Diagram block system

2.2 Software Design
The device is designed to use 1 controller. The controller uses an ATMega328 chip programmed using the Arduino programming language. If the sensor inside the box detects an object, the door will close automatically. The controller will activate the UV lamp in a few seconds. After the object is sterilized using a UV lamp, the buzzer will sound and the UV lamp will turn off. Figure 3 is a system flowchart from the controller.
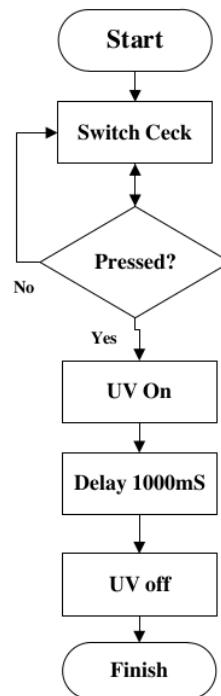

Figure 3. Flowchart System

3. Result and discussion

3.1. System Realization

The work of the tool is shown in Figure 4. The frame for the device is made using iron and a combination of plywood covered with paper. The sensor placement configuration looks like the description in Figure 4. A UV lamp is placed on the inside of the table. The buzzer will sound when the UV lamp is on. The device is also equipped with a wheel so that the tool can be used portable in various locations. The pin mapping used on the ATMega328 microcontroller chip is shown in table 1. The whole system uses only one controller.

Figure 4. UV box

Table 1. Pin Mapping

ATMega328 Pin	Sensor
2	Proximity
3	Switch
4	Buzzer
6	Relay UV

3.2. Testing result

Testing is done by experimenting with the work functions of various features on the device. The first is testing a wireless device with a face shield. From the experimental results in the room, the sound from the speakers can be heard well. Figure 8 is the condition when testing in the laboratory.

4

Figure 5. Wireless Microphone test

Furthermore, the UV sterilization box function test was performed. From the whole testing process, the system has worked well. Table 1 is the test result data. Figure 6 is the condition of the UV device when tested.

Figure 6. UV box sterilization

Table 2. UV test

Test	UV On	Work
1	1000s	Success
2	1000s	Success
3	1000s	Success
4	1000s	Success

4. Conclusion

The development of the Covid-19 pandemic has slowed things down. The imposition of social restrictions means that some activities cannot be carried out directly. The Ministry of Health has also implemented a health protocol for intense hand washing. In this research, a UV sterilizer was made to work well. This device can be used to help reduce the risk of exposure to the Covid-19 virus when implementing offline learning.

5. Acknowledgment

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