

Implementation of Touchless Automatic Hand Washer in Community Service Towards Adaptation of New Habits in Covid-19 Pandemic in Bandung City

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Abstract

Available handwashing sinks, especially during the early days of the Covid-19 pandemic, still required users to directly touch the water faucet and soap bottles. There were no guidelines for correct hand washing according to World Health Organization (WHO) standards, and water was simply wasted because the faucet was left open while scrubbing hand. Therefore, a device was developed in the form of a touchless hand-washing faucet using a sensor that can detect the presence of hands when one performing hand washing so that water only flows out when needed. The device is also equipped with a soap measuring system and indicators for soap or water containers that are full, half, or empty. To ensure that users can wash their hands properly, the device is also equipped with an announcer containing instructions for washing hands according to WHO standards. The developed device has been implemented in the field by installing it in three public places in the city of Bandung. The public can directly use this devices to fight the Covid-19 outbreak.

Keywords: Covid-19 pandemic, hand washing, health protocol, microcontroller, touchless handwasher, WHO standard

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Introduction

On March 2, 2020, President Joko Widodo announced the first two cases of Covid-19 in Indonesia. Since then, the number of Covid-19 cases had continued to increase. The first wave of Covid-19 cases in Indonesia occurred in January-February 2020. At that time, the highest number of daily Covid-19 cases occurred on January 30, 2020, with 14,528 cases (Wibowo & Nurita, 2022). This high number of cases was due to the rapid spread of the virus so that disease transmission could easily occur. To break the chain of the spread of the Covid-19 virus, one of the actions taken by the Indonesian government was to perform information dissemination and education about the new normal which was then narrated to become a new normal adaptation (Irawati, 2020).

The purpose of adapting to new habits was so that people could continue to work, study, and do activities productively. There were 5 things to do in adapting to this new habit: washing hands, wearing masks, keeping distance, staying away from crowds, and reducing mobility (Fadli, 2021). These five things are known as the 5M health protocol (*prokes 5M*).

Washing hands regularly is the first 5M health protocol and is very effective in preventing virus transmission. For maximum results, it is recommended to wash one's hands for at least 20 seconds using running water and soap. Washing hands is mainly done before touching food, after using the toilet, and after outdoor activities (Fadli, 2021). According to Germas and World Health Organization (WHO), there are six steps to washing hands properly, which the public must adhere to for maximum results (Kementerian Kesehatan Republik Indonesia, 2022).

Based on survey results in the field, it was found that there were many hand-washing sinks available in various public places that did not meet Germas or WHO standards and were not efficient in their use. Things that were found included: sink users still directly touching the water faucet and soap bottles, there were no guidelines for proper hand washing, and water was often wasted because the faucet was left open while rubbing hands with soap. For this reason, an automatic hand washing device without user physical touch was needed and this device utilization should follow the Germas and WHO standard procedures.

Based on the background of the problem, the formulation of the problem of this research is how to design a device for automatic touchless hand washing, or automatic touchless hand

washer, which can be used easily and practically by the community and also following Germas and WHO standards and how to implement the design. Washing hands without touching the device during a pandemic situation at that time could help the community in implementing the 5M health protocol.

The community service activities (*Pengabdian kepada Masyarakat*, PkM) that were carried out included device design, device realization, and direct installation of such devices in several strategic locations in the city of Bandung. The device built was a touchless hand-washing faucet system using sensors (Han et al., 2019) that can detect the presence of hands when washing hands so that water only flows when needed. The device is equipped with a soap dosing system with solenoid control and a water flow sensor, an indicator showing the condition of the soap or water in the container is full, half, or used up using a led and buzzer, and instructions for correct hand washing according to WHO standards.

It is expected that through this community service activity, the use of technology can be maximized through a simple device, such as a touchless hand washing machine, during a pandemic to help run the new normal era and at the same time provide insight into the public to always maintain health, one of which is by washing hands according to WHO standards.

Methods

This community service activity is carried out through the following series of stages, as also shown in Figure 1.

1. Conducting limited meetings (forum group discussion, FGD) with regional governments (*Rukun Warga*, RWs) regarding the handling of Covid-19 related to the *Adaptasi Kebiasaan Baru* (Adaptation to New Habits) program. Results of the meeting was as follows:
 - a. A device was needed to get people used to washing their hands properly according to WHO standards.
 - b. Device design based on appropriate technology (*teknologi tepat guna*, TTG) that can be implemented immediately.
2. Collecting data and reference studies.

This stage contains activities to re-collect data related to the concept of correct hand washing following the correct standards and to analyze the needs of the community during a pandemic. This stage also contain a survey of the target location for installing the device.

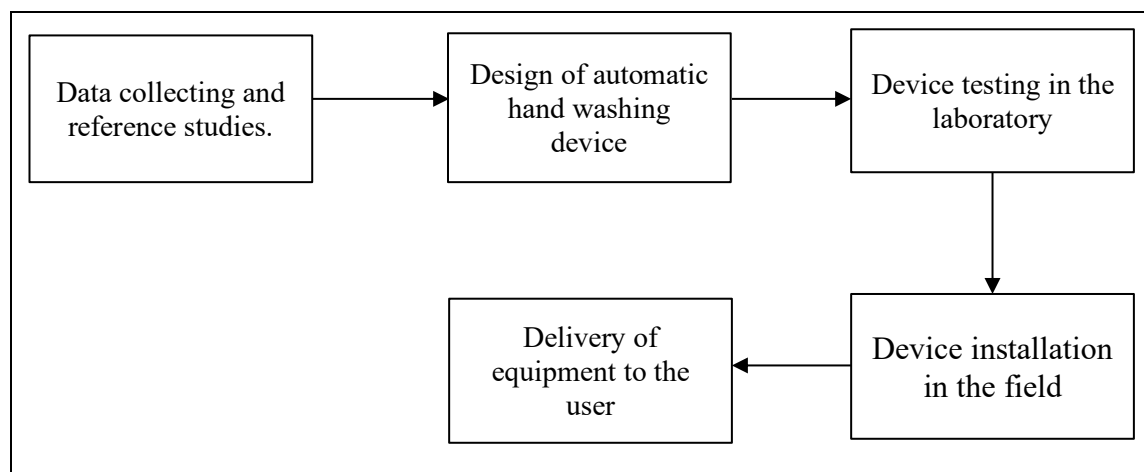


Fig. 1. Stages of community service activity

3. Designing a touchless handwashing device.

This stage contains the activities of designing a touchless hand washing system consisting of software and hardware then integrated into a functional device.

4. Testing the device in the laboratory

This stage is an activity of testing the device until it is finalized and ready to be installed in the field.

5. Installing devices in the appropriate locations

This stage is the activity of installing the devices in a predetermined location and ensuring the device can function as planned.

6. Donating the devices to the user

The final stage of this activity is to hand over the devices to the party that has been determined. The event for handing over the devices was also witnessed and attended by local community leaders, such as the *lurah* and *camat*.

7. Making documentation and publication

This stage compiles activity and financial reports as well as draft papers for publication.

The Concept of Washing Hands According to Health Standards

Hand washing is a procedure or action of cleaning hands using soap and running water or hand-rub with an antiseptic (alcohol-based). Hand washing is the most important basic technique in preventing and controlling infection transmission. Research (Luby et al., 2009) says that washing hands consistently with soap can reduce diarrhea and respiratory diseases. The results of research by government-private partnerships regarding the *cuci tangan pakai sabun* (CTPS, hand-washing using soap) program show that community knowledge about CTPS is high, but

practice in the field is still low (Purwandari et al., 2015). The hands are the part of our body that is most polluted by dirt and disease germs. When holding something and shaking hands, of course, there are germs attached to the skin of our hands (Potter & Perry, 2005).

The hand-washing technique is to clean hands with soap and clean running water (Ambarwati & Prihastuti, 2019). Equipment needed for washing hands is that each sink is equipped with hand washing equipment according to WHO standards, for example, a long-stemmed faucet to circulate clean water, a tissue dryer, hand towels, and liquid soap or hand sanitizer that functions as an antiseptic (WHO, 2009). Therefore, the infrastructure must also be adequate to support hand washing so that it can be carried out optimally.

The World Health Organization (WHO) recommends washing hands for at least 20 seconds before and after certain activities (WHO, 2009). The correct procedure for washing hands according to Germas and WHO standards is as follows (Farmalkes, 2022; WHO, 2009):

1. Wet hands, rub soap on palms then wipe and rub both palms gently in a circular direction.
2. Wipe and rub the back of both hands alternately.
3. Rub between your fingers until clean.
4. Clean fingertips alternately with the interlocking position.
5. Rub and rotate both thumbs alternately.
6. Place your fingertips in your palms and rub gently. Rinse with clean water and dry. All these procedures are repeated for approximately 40 - 60 seconds.

Design and Testing of Touchless Hand-Washing Equipment

Several community service and research activities related to touchless hand-washing devices had been carried out. Among them is a touchless hand-washing tool using a pedal, such as that developed by Dina Fitriana R., et al. in (Rosyada et al., 2022). Research conducted by Willia Cahaya, et al. in (Dita et al., 2021) developed an automatic hand-washing faucet with a voice reminder. The tool consists of an ultrasonic sensor to detect the presence of objects (people) with predetermined conditions and warnings in the form of sounds to wash hands.

The device developed in this community service activity consist of a main controller and a sensor that functions to regulate the discharge of water and soap. If there is an object (person) who will wash hands, the sensor will detect a hand approaching the tool within 10 cm. The sensor then orders the soap and water pumps to work alternately. The soap and water that

comes out of the faucet are timed according to the time frame for the correct hand washing procedure from Germas and WHO. Figure 2 shows the system architecture of the built touchless automatic hand washer.

The advantage of this device is that there are audible instructions in the form of voice for each step of hand washing that is carried out so that users can easily follow them. Table 1 shows the time frame for each hand-washing step accompanied by audio instructions. This time frame is also an indicator of the release of water and soap. It is also intended that water can be used according to its needs, not wasted.

To prevent soap from running out suddenly, this tool is designed to be able to give a warning when the soap available in the container is running out. Figure 3 shows a flowchart of the warning process. The flowchart shows the time (delay) set before water runs out and soap before it runs out. This delay time can be changed according to the user's request. When the warning sounds, the soap can be refilled immediately.

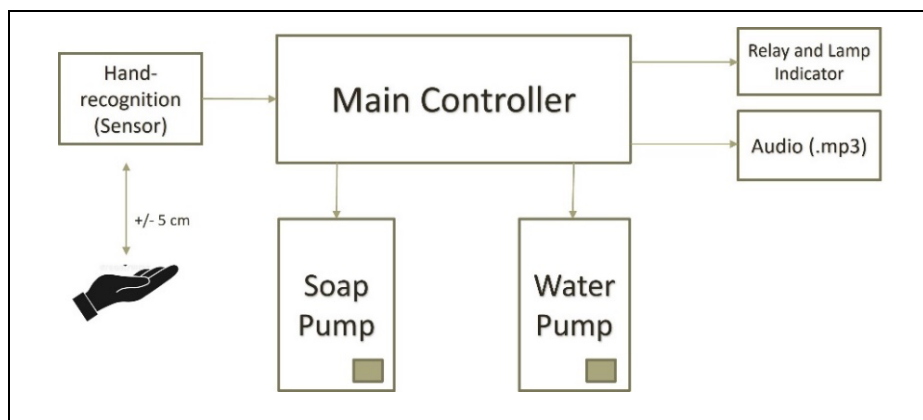


Fig. 2. The design of the system architecture of the touchless automatic hand washer

Table 1. The design of time frame of hand washing instruction according to WHO Standard

	Step-1	Step-2	Step-3	Step-4	Step-5	Step-6	Step-7	Step-8	
Audio (.mp3)	“Wet hands under running water!”	“Rub the backs of both hands alternately!”	“Rub between your fingers!”	“Clean the fingertips alternately with the interlocking position!”	“Rub and rotate both thumbs alternately!”	“Slowly palm with fingertips!”	“Rinse with clean running water!”	“Dry with a warm fan or tissue. Thank you! Have a good activity. Don't forget to wear a mask!”	
Duration in second	5.5	4.1	3	3	3	3	10	11	
n-th second:	0	5.5	9.6	12.6	15.6	18.6	21.6	31.6	
	Total in second								42.6

This device was designed in such a way that installation can be done easily by anyone. The installation configuration is shown in Figure 4. The equipments needed for the installation include a water source, a power source, pipes for draining water, and several tools for installing water pipeline in general.

Results and Discussions

Results

After going through the design and testing stages in the laboratory, the device was ready to be installed. Based on the previous survey, it was determined that there were three locations for installing this touchless automatic hand-washing device. The three places are:

1. *Polsekta* Bandung Wetan office on *Jalan Cihapit*, Bandung. This police station is open 24 hours to serve the community.
2. On *Jalan Geusan Ulun* (near *Jalan Sultan Agung*), Bandung.
3. At GKI Cibunut, *Jalan Cibunut*, Bandung.

The three places were chosen because they are places that are widely accessed by the public. At that time the community's activities were limited by the existence of regulations regarding *pembatasan sosial berskala besar* (PSBB, large-scale limitation on social interaction), but certain activities were still carried out in these places. *Polsekta* Bandung Wetan office is open 24 hours to serve the community so the need to wash hands is quite high. On *Jalan Geusan Ulun* which is a main road, there are so many people and pedestrians passing by in the area, so they need a place to wash their hands. At GKI Cibunut, the activities were indeed reduced, but there are regular activities of the church office staff and church congregations, so they need a place to wash their hands that is quick and easy to access.

Polsekta Bandung Wetan, residents of RW 03 *Kelurahan Citarum* and RW 05 *Kelurahan Cihapit*, and GKI Cibunut church acted as partners in this *PkM* activity. They have expressed their willingness to contribute in terms of providing land to house the automatic handwashing device, electricity to power the device, water and soap sources for community use, and manpower to maintain the device.

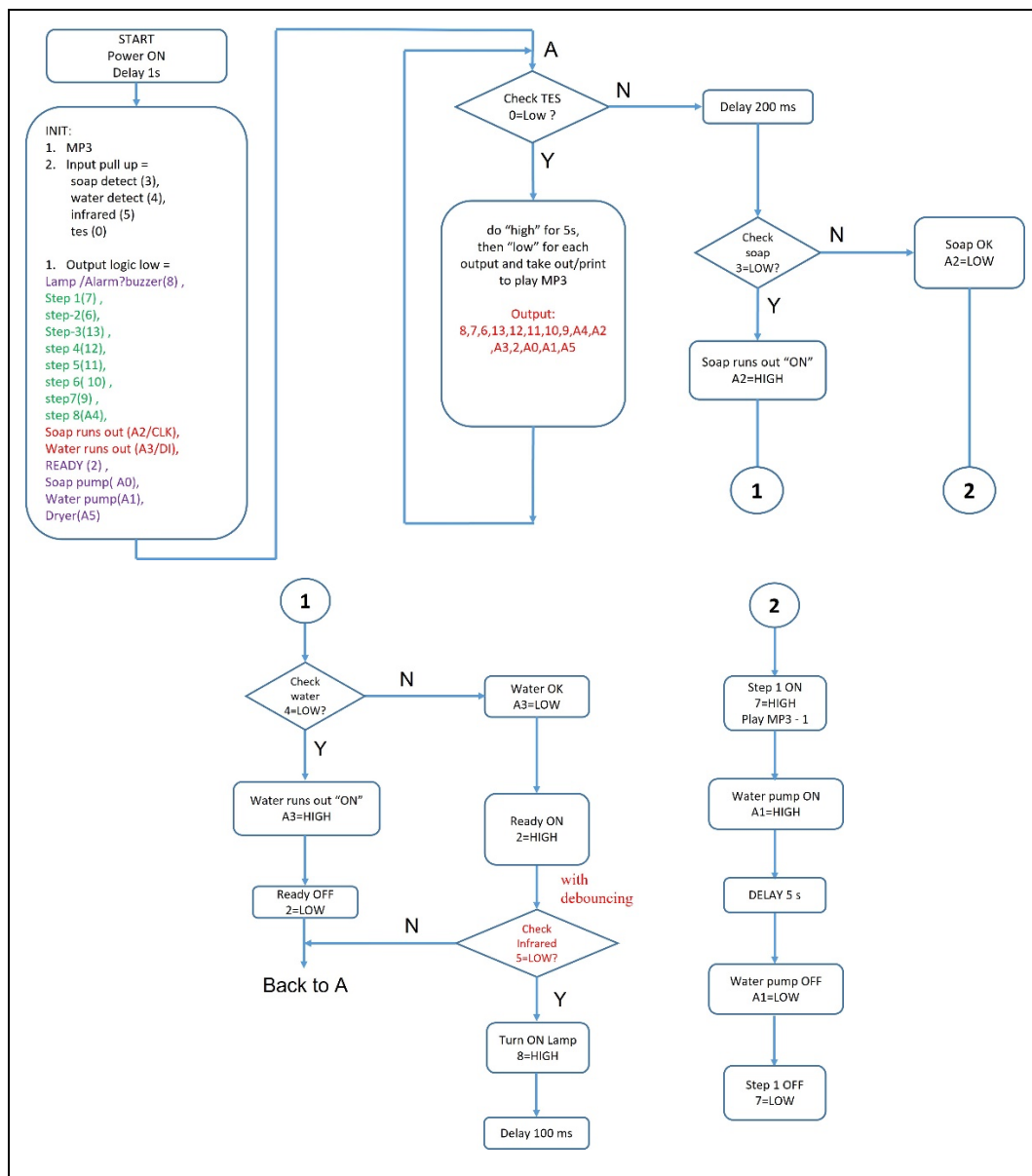


Fig. 3. Water and soap availability notification flowchart

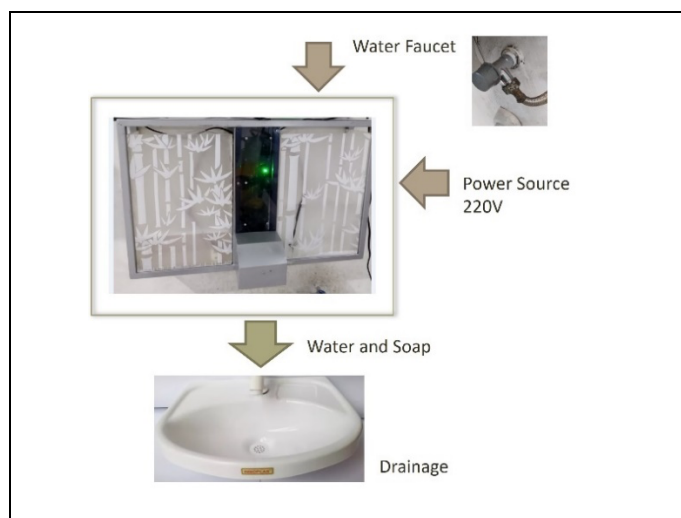


Fig. 4. Configure the installation of the hand-washer

After the device was installed, a handover event was held for the user as well as the information dissemination about the usage and maintenance of this touchless automatic hand washing device. The handover event for the *Polsekta* Bandung Wetan was held on June 15, 2020, in person (onsite) at the office which is located at *Jalan Cihapit no. 7A*, Bandung. By continuing to apply for the strict 5M health program, the handover event could take place smoothly. The event was attended by representatives of the *Kapolsekta* Bandung, the head of local RW, *Kelurahan Cihapit*, and the residents.

Before the handover event, the hand-washing device had already been installed and confirmed to be working smoothly. The installation of the equipment was carried out by the community service implementation team assisted by staff from the police station. The device was installed according to the configuration that has been designed, as shown in Figure 4. The *Polsekta* Bandung Wetan office already has manual for the hand washing device, a sink and its seat, and a water drain. Without changing the existing facilities, this touchless hand washing machine was installed side by side with the existing sink. Water sources and sewers take advantage of existing ones. The device that have been installed at the *Polsekta* Bandung Wetan can be seen in Figure 5a and 5b, respectively.

The handover ceremony for the automatic hand washing device installed on *Jalan Geusan Ulun*, Bandung was carried out during the *Program Lembur Tohaga Lodaya RW 03 – Kelurahan Citarum*, Bandung. This event was organized by residents of *Kecamatan* Bandung Wetan on June 30, 2020. The event which took place from 10.00 to 14.00 WIB was attended by the community and RW 05, *Kelurahan Cihapit*, the community and RW 03, *Kelurahan Citarum*, and *Kecamatan* Bandung Wetan. On that occasion, the Mayor of Bandung was also present to inaugurate the event. This event was covered by a national private television station and broadcasted on August 31, 2020. This touchless automatic hand washing machine was covered in the news broadcast.

Similar to the device that was previously installed at the Bandung Wetan *Polsekta* office, the device installed on *Jalan Geusan Ulun* had also been installed and confirmed to work smoothly before the handover ceremony. Since the installation position of the device was on the sidewalk of the main road, a water source and its channels were needed. Therefore, this touchless hand washing machine was installed in front of one of the resident's house to obtain water sources (see Figure 6). In addition to installing hand washing equipment, a water channel was also built

from a water source. The operation of this device is regulated and maintained in such a way by residents to avoid improper or deviant use. This device was installed at a certain height so that it can also be used by persons with disabilities in wheelchairs (see Figure 7).

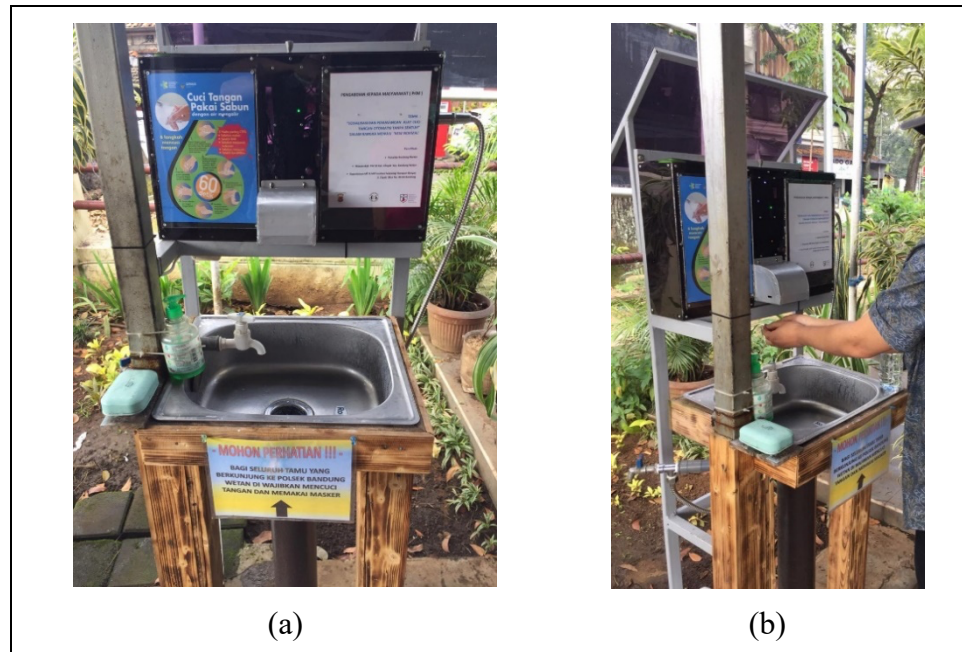


Fig. 5. (a) Touchless automatic hand washing machine installed at Polsekta Bandung Wetan office and (b) Device can be used by public

The third location for installing the touchless automatic hand washing machine is at GKI Cibunut, Bandung (see Figure 8). The device is installed beside the main entrance of the prayer room for easier access. Previously, there was no water channel in this area, so a water channel was built first from the water source along with the drainage channel.

Discussions

This activity did not experience significant obstacles. With the ease of using the device and also ease of maintaining it, the people who received donations of this touchless automatic hand-washing machine have said that it is very helpful in terms of washing their hands. Some of the deficiencies found in this touchless automatic hand-washing machine include:

1. The hand-washing soap reservoir is a bit difficult to refill.
2. The position of the placement of device that are still attached to conventional hand washing station. This case occurred in a device installed at the Bandung Wetan *Polsekta* office.



Fig. 6. A touchless automatic hand washing machine installed on *Jalan Geusan Ulun*, Bandung

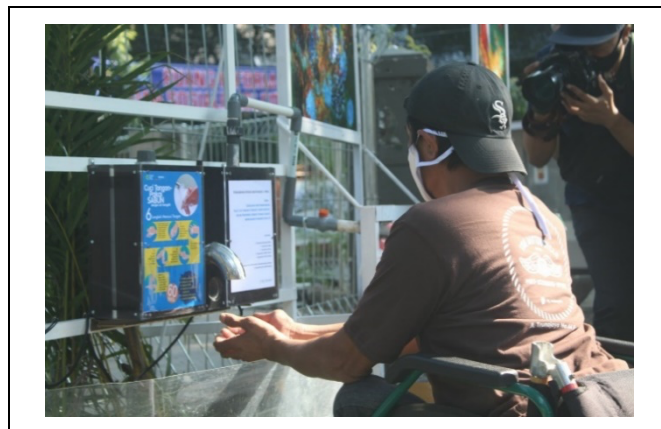


Fig. 7. This touchless automatic hand washer is disability friendly

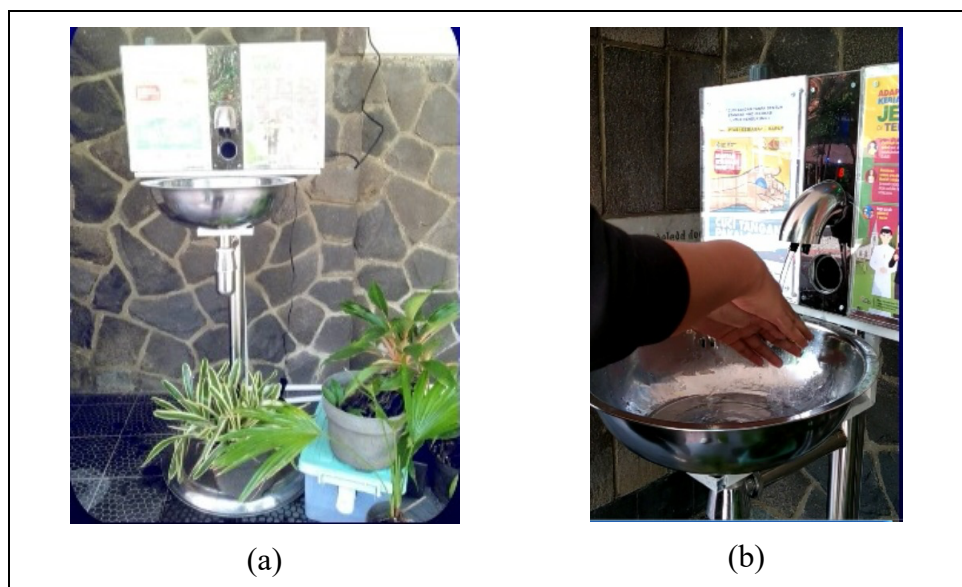


Fig. 8. Automatic hand washing equipment installed at GKI Cibunut, Bandung

3. The pressure from the water source is sometimes too strong so a leak occurs in the device which is at risk of hitting the electronic and electrical parts. This case occurred in a device installed on *Jalan Geusan Ulun*.
4. During the preparatory period for the community service activity, team coordination was carried out online via internet meeting application, so that the implementation of activities in the field could not be attended by the entire team, only representatives.

Alternative solutions to the problems mentioned earlier include:

1. Need to redesign the hand washing soap reservoir to make it easier to refill soap.
2. Because the device is attached to a conventional hand washing station, it is necessary to remove some of its supporting components, such as clean water and drainage channels.
3. The pressure from the water source needs to be considered before the device is installed so that it can anticipate leaks in the tool. Electronic and electrical parts need to be protected with waterproof covering.

Overall, the touchless automatic hand washing machines have worked according to the planned target. Starting from removing water and soap as well as supporting audio for hand washing instruction steps according to WHO standards works as intended, so the devices can be used properly.

Conclusion

Touchless automatic hand washing devices have been successfully designed and realized to help people maintain cleanliness and health during a pandemic. These devices were also donated to the community, especially residents in several locations in *Kecamatan Bandung Wetan* area. Communities can directly benefit from this device.

The implementation of this device is also a field trial. The deficiencies found, both during the installation of the device and when the device is used by the community, are used as notes or input material. This input is very important and useful for the improvement and development of this device in the future.

It was expected that through this community service activity, the team would be able to contribute to the field of science and technology and engineering, especially in the field of electronics, to help the community in fighting the pandemic that was sweeping the whole country at that time.

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