

# Automated Processes of Preparing and Washing Deceased during Pandemic

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**Abstract**—In pandemic periods, the deceased are either in large numbers as a natural disaster or a carrier of infectious diseases as in pandemic times. Dealing with the deceased by a human is challenging for high numbers of deceased, as in natural disasters. In addition, it may transmit disease to the people who wash and prepare for those deceased during the pandemic. This paper will introduce a proposed system in pandemic situations and natural disasters to prevent people from contacting the deceased directly. The system includes an automated bathing chamber designed to make a device that cleans, bathes, and packs cadavers or bodies. It is also designed to cater to cheerful COVID-19 corpses, wherein the current guide for Muslim carcasses, the conventional cleaning process for burial procedures, is to be abandoned. The procedure is about the guidelines provided by the government in handling COVID-19 Muslim corpses in 2020. The policy states that if the corpse is a confirmed COVID-19 case, performing the tayammum on the surface of the plastic bag is adequate to eliminate any risk of COVID-19 transmission. Nowadays, this idea is for an Automated Bathing Chamber specializing in cleaning, sanitization, and packing positive COVID-19 cadavers. An initial design for the device can be visualized as a washing machine that fits a body. Furthermore, the proposed system can also provide benefits in managing the deceased who died due to infectious diseases and facilitate the bathing process for homeless cadavers and unclaimed deceased.

**Keywords**—COVID-19, pandemic, burial, automated cell, washing, Islamic burial

## I. INTRODUCTION

In general, the dead body washing and dressing the deceased before burial is an act of dearest and obligation in religions such as Islam, Christianity, and Judaism. Cleaning the body to eliminate odors is challenging and tedious because the dead body loses all functions after death. In addition, many germs and microbes exist on a human deceased's skin, presenting health contamination to the person responsible for the work [1]. The automatic deceased washer has been a local response to the traditional burial process with religious rituals. However, this technology has faced criticism from religious scholars and ordinary people [2]. With a history since 2014 in Iran, the automatic deceased washer has targeted another critical aspect of religion and life: 'death.' Modern ways of rationalizing death, including efficiency, calculability, and hygiene practices, have transformed how death is perceived in Islamic society [3,4]. The

Epidemic's Rise and Decline traces social, cultural, geographic, and political histories and uses historical evidence to challenge key epidemiological assumptions about population movement, transmission, local ecologies, and association with zoonotic risks [5]. A survey was done on the existing robotic solutions that could be employed for pandemic care to present a systematized description of desired robot properties based on a particular application area and target users to propose a new generation infection hospital framework that integrates existing robotic tools toward pandemic mitigation and discuss ethical aspects of their use within the framework [6]. A similar system was implanted for older people to solve problems related to bathing in different situations and environments [7,8]. One study compared a mortuary ritual across 57 representative cultures. It demonstrated that the kin of the deceased engage in behaviors to prepare the deceased for disposal that entails close and often prolonged contact with the contaminating corpse [9]. Animals such as chimpanzees have been observed using tools to clean the corpses of a deceased group members [10].

This study aims to design the automated steps of preparing and washing the corps, simulate the designed line using Automation Studio, and implement a prototype line system using a controller.

## II. PREPARING AND WASHING DECEASED IN DIFFERENT RELIGIONS

Different religions have differences and similarities in preparing the deceased. The deceased need to be prepared and washed in many religions. That leads to benefits from automated or semi-automated processes, especially in pandemic situations or many deaths such as in war or natural disasters.

### A. Islam

Washing the dead is obligatory, obligatory enough; Because the Messenger, peace, and blessings are upon him, commanded the washing of the dead, he washes as a living believer washes his whole body from his head to his feet once. Washing is an obligation, and it is better to start with the places where ablution is; Because the Messenger commanded to begin with the areas of ablution, he wipes his teeth and nose and washes his face three times better, and his arms with the elbows three times. He wipes his head with his ears. He washes his feet, whether male or female, then pours water on his head three times, washes it with

water and Sidr, and then pours water over his body. Washing Start with the right incision before the left so it permeates the body once. That process is obligatory, and if repeated three times, it is better, and if it is washed three or five times, it is better for an odd string, which is the best.

Furthermore, if it has dirt or plasters on it, he increases the washing until all the dirt is removed, even if it is seven, but an odd number is better until the dirt and plasters are removed, and the body is purified with water and Sidr. Camphor should be present in the last wash with some camphor. Because this sweetens the body, hardens and strengthens it, and sweetens the scent. Then he shall be shrouded in a garment that covers all from his head to his feet, a piece of the garment covering it, and preferably in three coils as the Prophet, peace, and blessings are upon him, was shrouded in three coils, spread out one over one, then wrapped over him, and over his head and under his feet with a belt, and so on his waist.

#### B. Judaism

Judaism traditionally does not allow cremation. In Judaism, the soul is anxious for its body to receive a proper Jewish death ceremony, namely a burial. Bodies cannot be touched for at least 20 minutes after death, but funerals should be held within 24 hours. Jews should be buried in simple, handmade, white clothing without emblems in addition to cleaning the body. The cleansing is part of a ritual performed by qualified Jewish funeral practitioners called taharah. The actual washing of the body is called the Tahara, and the Chevra Kadisa strips the body of all clothes and covers it with a white sheet. They begin washing with cold water while saying a biblical psalm that mentions cleaning the organ. After the second round of washing, the body will be dressed in the tachrichim, a simple linen garment.

#### C. Christianity

The various ranges of death customs in Christianity reflect the different sects of their faith. A Catholic priest will provide a final confession, whereas a Protestant minister will not. Following death, a Christian funeral is usually held around a week at a church or a crematorium. In Christianity, cremation is acceptable even to more conservative practitioners.

The Orthodox Christian's body was deceased and washed and dressed before burial. Although this custom does not impose any ritual purity, it should be performed by family members or friends of the deceased. The Absolute is a symbolic ablution of the deceased's body in the Roman Catholic Church. The coffin is sprinkled with holy water.

#### D. Hinduism

Hinduism stipulates that the family keeps the body covered, washed, and dressed. Afterward, they burn the deceased and scatter the ashes in the river.

#### E. Buddhists

Buddhists believe that the soul leaves the earthly body after death. Buddhism's death customs vary from sect to sect, and Buddhists can dispose of a body by any four elements: earth, air, fire, or water. Around 80% of Tibet people, the mainly Buddhist population, choose their bodies to be cut up and placed on

hillsides and removed by vultures. Called 'sky burials,' these ceremonies express generosity towards nature.

### III. AUTOMATED SYSTEM FOR PREPARING AND WASHING DECEASED

Many religious followers believe in washing the body and dressing the deceased before burial, an act of love and necessity. Since the deceased lost all bodily functions, cleaning the body eliminates odors. Microbes and germs are present on a human deceased's skin, presenting a health risk to the persons performing the task. Therefore, people must refrain from physical contact with dead bodies.

The preparation of the deceased in Islam is usually carried out in specially designed washing rooms at cemeteries in cities. This preparation consists of two essential operations: washing the deceased "Ghosl" and wrapping the body in a shroud "Kafan." The following section will describe the traditional method of these procedures following Islamic rules. One should note that we intentionally used graphics to illustrate the whole process due to the graphic nature of the subject.

In Islam, the preparation of the deceased for burial takes place in three steps: washing, drying, and shrouding in washing rooms at cemeteries. In Islam, the deceased of a Muslim should be wrapped with three pieces of cotton fabric. The first covers the body from the belly button to the knees, the second covers the shoulders and half of the legs wrapped around the body, and the third covers the whole body, including flaps to cover the head and feet. The overall fabric is banded and tied upon closing the shirt and shroud as a final step.

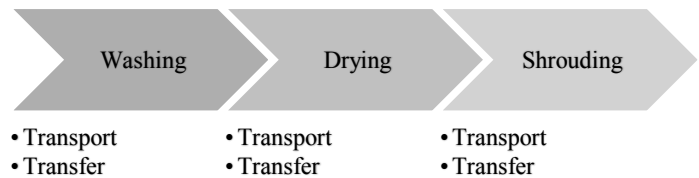


Fig. 1. Operations stages.

It is mandatory in Islam to perform Ghosl for various occasions. Morally, since the deceased is defiled by death. Ghosl traditionally achieves this under the following procedures:

1. Remove cloth and apparel, and cover the genitals by placing a piece of fabric.
2. Lift the body slightly, and do a smooth massage to the chest and stomach for any unevenness.
3. Before starting Ghosl, the deceased is washed with soap and water.
4. Rinsed the body must be with a cedar solution.
5. Wash and rinse the body using camphor.
6. Rin the body thoroughly with pure water and air-dried.

### IV. THE OPERATIONAL PROCEDURES

#### A. Primary Preparations

The first part of Ghosl's operation is to prepare the deceased for further actions. After delivering the deceased to the Ghosl place, the operators will remove all clothing and personal apparel, such as rings, watches, and jewelry. Then, they clean

makeup, marks, injury, and all nail polish on the body's skin. The initial preparations are all done manually.

### B. The Transfer Table Stage

When the body is prepared for washing, the deceased is placed on a transferring table equipped with rollers or a conveyor belt for more effortless movement. The transport table has two wheels that move on a rail using two motors attached to the table. The table includes a conveyor belt to transfer the corps to the shrouding table. The conveyor belt, which operates using an engine, is a wire mesh belt with horizontal rods placed at a distance from one another.

In Islam, the Ghosl is complete if all body parts are exposed to spraying water. For this reason, it guarantees that the skin will be directly exposed to water. The curved and sinusoidal path is designed to be used on the transfer table that the wire mesh conveyor belt is moving within. This motion will cause the contact body parts to the conveyor to change their position continuously; thus, the whole skin surface will be exposed to water directly according to Sharia rules.

### C. The Washing "Ghosl" Stage

After placing the deceased on the transfer table, it is moved to the washing chamber; then, the washing operation will begin. This operation is performed in a manner remarkably. Numerous showers are precisely designed and placed at the washing chamber to ensure all body parts receive water with appropriate amounts and solutions, such as soap, cedar, and camphor, rinsed thoroughly multiple times.

### D. The Drying Stage

It is recommended to dry the deceased After Ghosl and before shrouding. In this stage, the body will be scented and air-dried shortly after the Ghosl. Further, the manual placement of cotton on the genitals and in the orifices of the deceased prevents any possible fluid discharge. The unpleasant smell produced naturally in the area in the washing room will be reduced by using a drying fan and ventilator within the enclosed air-drying stage. After drying the body, it will be moved using a conveyor into a shrouding table as the last stage. After this stage, the deceased is prepared for funeral services and burial. The shrouds of a Muslim male deceased shall include three pieces of white cotton material. Once the deceased is transferred to the "shrouding table," the shrouding operation is performed semi-automatically.

## V. THE THEORY OF ACTION OF THE WASHING MACHINE OF THE DEAD

The machine or machine consists of a table on a slider that holds three belts of belt length 100 cm. The sliding table represents the X-axis. Second, four nozzles of the water flow move transversely on the table, sliding and defining the y-axis two of the nozzle at the bottom and two from the top. The table is divided into three one-meter belts to move the body from the top of the head to the end of the feet, where the nozzles for the conversion process wash the area based on their proximity to the nozzle. The upper or lower nozzle or both can be operated. The pump is mounted on a clean water tank with a pressure valve to push water into nozzles and compress water to the four nozzles. Water is pushed into the nozzles through a pump installed on a

clean water tank with a pressure valve for safety and compresses the water to the four nozzles, which are controlled by four valves. The movement of the transverse nozzles is controlled on the Y-axis sliding table.

### A. Problem

The problem of automatic washing of the dead stands out in several points that are as follows:

- 1- When placing the body on a table, water's difficulty is reaching all body parts, especially under the body.
- 2- Washing in Islamic law does not mean just touching the body randomly. However, it has a particular protocol represented in the ablution first for the dead and then washing the right slit of the body and then the left slit, and this highlights another problem for us which is determining the shape and size of the body and then determining its organs separately such as the head, palms, and feet, etc.)
- 3- If our handling of the body is full length, we will have to have the length of the washing machine twice the length of the body, such as if the body is 2 meters, then the length of the device will be 4 meters due to the stability of the nozzle of the flow of water.

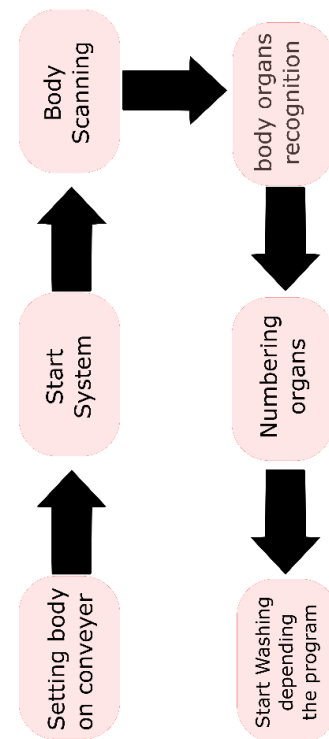


Fig. 2. Operation process processing sequence.

### B. Methods of Solution

There are several solutions available to avoid the problem of water reaching the rest of the body from above and below, which are as follows:

- 1- The table is in the form of a mesh interspersed with water during the washing

- 2- The presence of mounts and arms through which the body can be flipped.
- 3- The belt has more than one part with an incision to exit the water. The option is characterized by water reaching all body parts without any obstruction, such as the grid, columns, or others. This option has been adopted in this research as the best option.
- 4- Following Islamic law includes a method of washing the dead. It is necessary to determine the shape of the body and its organs using a scanner at the body moved to the machine entrance that is done using determining the shape of the body and using artificial intelligence to identify organs such as hands, face, head, arms, and feet.
- 5- The machine length problem can be overcome by placing the axis of the water flow nozzle represented by the Y axis in the form of two axes, one of which we deal with from 0 to 100 cm. The other is used for greater than 100 cm up to 200 cm so that we can cover the entire body if it is 200 cm long or less.

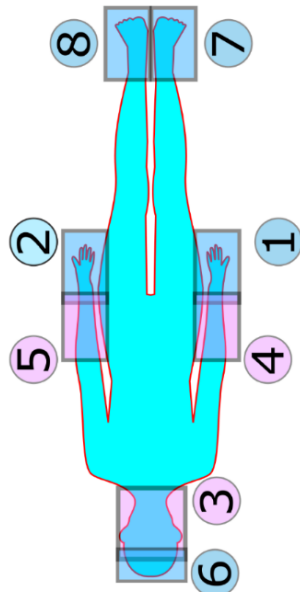


Fig. 3. 1- right palm, 2- left palms, 3- faces 4- right arm 5- left arm 6- head 7- foot right, 8-foot left.

### C. Operation Process Processing Sequence

1. Presets before entering the sink
2. Putting the dead on the walk on the sliding table properly closes the openings such as the mouth, nose, ears, and anus, opening a new line.
3. Placing the body of the dead on the sliding table in the right place after closing the body openings such as the mouth, nose, ears, and anus, and these openings are closed by pieces of rubber specially designed for the automated washing process to prevent water from entering the body and in the following figure we show models of these pieces.

4. Second, press the start key and insert the slider into the laundry room. Thirdly, the scanner scans the body as it enters the laundry room. The body's shape is determined and stored in controlled memory through the body recognition program.
5. The palms, arms, head, face, and feet are also indicated to the right side, and the left side and each area are given a specific number. For example, the correct palm number one, palm left number two, face number three, right arm number four, left arm number five, head or hair number six, valid foot number seven, and left foot number eight. In the following figure, we notice the numbering that we mentioned earlier.
6. After identifying the eight areas, the moving traffic is moved from the beginning of the number one zone. The water nozzles parallel to the lower and upper right palms are turned on, and the walk moves towards the end point towards the right, according to the figure below:

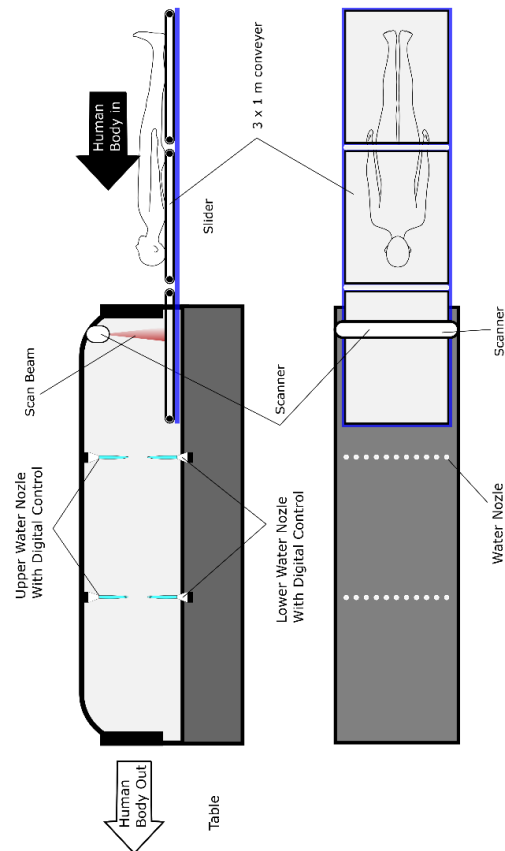


Fig. 4. Operation washing system.

### D. Operation Conditions

- The process of recognizing the body and identifying its organs
- Through the golden ratio, the organs of the body can be recognized by the total length of the body
- First, the body is divided into two sides, the right side, and the left side

- Then the right palm is determined after the left palm is numbered right and left palms by one number and number two based on their order in the ablution process
- The facial area is recognized and identified
- Then recognize and select the area of the right arm and then the location of the left arm and take in order four and five
- The area above the head or hair is selected, and you take the number six
- The feet area is determined to the right foot and left foot and takes the two numbers 87

#### E. Ablution Process

After determining the members' areas from one to eight, work is done on two axes: the X-axis and the Y-axis of X, which represents the traffic, and the Y-axis, which means the movement of the nozzle of the flow of water.

### VI. CONCLUSION

The conceptual design of the machine as a novel semi-automatic cell for the washing and preparation of a Muslim deceased before burial following Islamic Shariah laws has been introduced and proposed. The process cycles in the conceptual design include washing, drying, and shrouding stages that follow regulations and religious rules. The project was initiated to speed up the manual operation and reduce the burden on the personnel in the traditional deceased washing rooms "Ghassal Place" presented. The process cycles in conceptual design include eliminating or reducing the contact between personnel and the deceased to avoid possible health risks of infection. In addition, the automatic system reduced the operation time from washing to shrouding to approximately 10 minutes per deceased, which is about one-third of the time required by the present way.

Furthermore, the system tends to reduce the water consumed in the process. Computer software has designed and animated the procedure and system to examine its feasibility. The system manufacturing and testing based on the design presented here are the subjects of the subsequent phases of the project.

### REFERENCES

- [1] Meghdari, A., K. G. Osgouie, E. Nasiri, A. R. Nemati, and A. M. Mortazavi. "Conceptual design and simulation of a semi-automatic cell for the washing and preparation of a deceased prior to an Islamic burial." *International Journal of Advanced Robotic Systems* 9, no. 2 (2012): 42.
- [2] Mohammadi Doostdar, Hamidreza, Hossein Mohammadi Doostdar, Mohd Hazim Shah, and Hamideh Sattari. "A Stylish Burial: Tracking the Socio-Technical Aspects of Death in Iran." *Journal of Development Studies* 50, no. 6 (2014): 855-863.
- [3] Hamidreza Mohammadi Doostdar, Hossein Mohammadi Doostdar, Mohd Hazim Shah & Hamideh Sattari (2014) A Stylish Burial: Tracking the Socio-Technical Aspects of Death in Iran, *The Journal of Development Studies*, 50:6, 855-863
- [4] Hamidreza Mohammadi, Doostdar. "Questioning technology in Iran: Tracking the intersection of Islam, culture, and philosophy/Hamidreza Mohammadi Doostdar." Ph.D. diss., University of Malaya, 2017.
- [5] Richards, Paul. *Ebola: how a people's science helped end an epidemic*. Bloomsbury Publishing, 2016.
- [6] Evgeni Magid, Aufar Zakiev, Tatyana Tsoy, Roman Lavrenov & Albert Rizvanov (2021): Automating pandemic mitigation, *Advanced Robotics*.
- [7] Bezerra, Karolina, José Machado, Vitor Carvalho, Marcelo Castro, Pedro Costa, Demétrio Matos, and Filomena Soares. "Bath-Ambience—A mechatronic system for assisting the caregivers of bedridden people." *Sensors* 17, no. 5 (2017): 1156.
- [8] Bezerra, Karolina, José Machado, Vitor Carvalho, Filomena Soares, Demétrio Matos, Marcelo Castro, Filipe Pereira, and Hugo Lopes. "A new methodology for use by a single caregiver to bathe bedridden elderly persons using advanced mechatronic systems." In *Healthcare*, vol. 7, no. 4, p. 124. MDPI, 2019.
- [9] White, Claire, Maya Marin, and Daniel MT Fessler. "Not just dead meat: An evolutionary account of corpse treatment in mortuary rituals." *Journal of Cognition and Culture* 17, no. 1-2 (2017): 146-168.
- [10] Van Leeuwen, Edwin JC, Katherine A. Cronin, and Daniel BM Haun. "Tool use for corpse cleaning in chimpanzees." *Scientific Reports* 7, no. 1 (2017): 44091.