

## **Sensor Synchronizing Soap and Water Dispensing Hand Wash Equipment. (ELDISMART Hand Wash)**

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**Abstract:** *Our hands are a critical vector for transmitting microorganisms. The cross-transmission of these organisms to others occurs when we fail to wash hands effectively. Within health care systems and services, there have been almost continual awareness campaigns in place to encourage hand washing among health service personnel, patients and visitors. The current COVID-19 pandemic has seen a focus of education and information on hand washing aimed both at people working within the health sector as well as to the general public. There has been a proliferation of public health messages through various sources about the importance of hand-washing, and the correct techniques for hand washing. Hand-washing with soap, when done correctly, is critical in the fight against COVID-19. Recently the World Health organization (WHO) released interim guidance recommending to all Member States to make hand hygiene facilities in front of public and private commercial buildings as well as at all transport hubs obligatory. It is intuitive to think that the less a potentially contaminated surface is touched, the better, so the advent of automated sink fixtures as well as soap and towel dispensers has been heralded as an important way to reduce the opportunities for cross contamination and hand carriage of pathogenic microorganisms. This invention is a sensor actuated non-contact technology to ensure effective hand washing with zero contact on the hard surfaces which are significant transfer points for bacteria and viruses. The prevention of cross-contamination at washing point is total.*

**Keywords:** *COVID 19, Viruses, No-Contact, Hand-washing, Sensor, Technology*

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Date of Submission: 25-02-2022

Date of Acceptance: 06-03-2022

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### **I. I Introduction**

The coronavirus disease 2019 (COVID-19) is declared as a public health emergency worldwide by the World Health Organization (WHO). Increasing evidences have demonstrated human-to-human transmission that primarily affects the upper respiratory tract followed by lower respiratory tract damage leading to severe pneumonia. Based on the current status, the elderly population and people with prior co-morbidities are highly susceptible to serious health effects including cytokine up-regulation and acute respiratory distress syndrome (ARDS). Currently, COVID-19 research is still in the preliminary stage necessitating rigorous studies. There is no specific drug or vaccine targeting SARS-CoV-2 currently and only symptomatic treatment is being administered, but several antivirals are under active investigation (Muralidar *et al.*, 2020).

As the COVID-19 pandemic spreads across the globe, millions of people are heeding the advice of health experts to wash their hands. A simple tool to promote public health, hand washing is one of the most effective ways to prevent transmission of disease—not just the coronavirus (e.g. COVID-19), but also diarrhoea, cholera, and typhoid. The two main routes for the transmission of COVID-19 are respiration and personal contact. Measures recommended to contain human-to-human transmission include isolation, quarantine, social distancing and community containment. These measures have proven to be effective in containing the spread of the virus. In addition, the WHO & UNICEF have recommended some basic measures to help reduce the spread of COVID-19. They include frequent washing of hands for at least 20 s using water and soap. Hand washing is effective in curbing infectious diseases. It is reported that hand washing reduced transmission of respiratory viruses by 45–55% (Mensah *et al.*, 2021).

Hand hygiene has been described as the cornerstone and starting point in all infection control programs, with the hands of healthcare staff being the drivers and promoters of infection in critically ill patients. Hand hygiene has been identified as the treating intervention strategy that will drive down cross-transmission of pathogens in the healthcare environment. Hands hygiene practice is reported to be the simple and important

procedure to reduce the spread of infection in the community and health care settings during Coronavirus (COVID-19) outbreak (Mohammed and Khameis, 2020). Various Covid-19 hand wash units, ideal for hospitals, markets, offices and factories are fabricated and kept at the premise's entrances. But the water and soap dispensing knobs of most of the hand wash sinks are hand operated; implying countless possibilities of further virus spread through the knobs.



Plate 1: Hand-operated Hand Washing Machine      Plate 2: Make shift Hand-operated Hand Washing Machine



Plate 3: Foot-operated Hand Washing Machine P      late 4: Foot-operated Hand Washing Machine

The pictures shown above depict the principles of the various conventional Hand Washing gadgets. Plates 1 and 2 are hand operated while Plates 3 and 4 are foot operated. Variations of the two abound in many places as measures against Covid 19. The touching of the knob by hand and the pedal by foot present contact points which can become contagious points. In most cases the soap are also manually dispensed. It is intuitive to think that the less a potentially contaminated surface is touched, the better, so the advent of automated sink fixtures as well as soap and towel dispensers has been heralded as an important way to reduce the opportunities for cross contamination and hand carriage of pathogenic microorganisms. No contact technology is a good idea, because the knobs' surfaces are significant transfer points for bacteria and viruses. Sensor Synchronizing Soap and Water Dispensing Hand Wash Equipment (ELDISMART Hand Wash), is a novel no-contact technology of Electronic Development Institute (ELDI), Federal Ministry of Science and Technology (FMST) Awka in collaboration with the National Board for Technology Incubation (NBTI), Federal Ministry of Science and Technology (FMST) Abuja. It ensures zero contamination at the wash points.

## **II. Objective of Invention**

Existing hand washing machines require the hand or foot to touch a part of the machine for water and soap to be dispensed. Each user would necessarily need to touch the same parts; creating some possibility for contamination from a virus-carrier user. The objective of the invention is to create a hand washing machine which dispenses soap and water without the need to touch any parts of the machine with hand or leg. This is to ensure total non-contamination of a user by previous users. Electronic sensors and actuators are employed to actuate the soap and water pumps while sensing the hand close to the mouth of the tap.

### **III. Statement of Invention**

Conventional hand washing machines are gravity fed and mainly consist of water containers and soap containers, In the hand operated machine, the user manually dispenses the soap into his hands and manually opens the water tap to wash his hands. In the foot operated hand-washing machines, the user pedals a lever which opens the soap dispenser and then pedals another lever which opens the water tap. This invention is solar powered and consists apart from the containers holding soap and water, two submersible electric pumps for pumping liquid soap and water respectively. The pumps are actuated by electronic sensors. Other features include:

- i. Power on switch and LED indicator
- ii. Automatic dispensary of soap and water.
- iii. Smart detection of users' hand.
- iv. Alarm beep on system activation.
- v. Allows appropriate time for proper hand washing in line with the specifications of NDC.
- vi. Low battery indicator and alarm
- vii. Continuous alarm beeps on low water level detection.
- viii. Dual power supply system, solar and ac sources
- ix. Regulated and manual water inlet provision.
  - x. Visual soap level indicator.
  - xi. Plastic water container capacity 235litres.
  - xii. Water discharge port.

### **IV. Innovation Design**

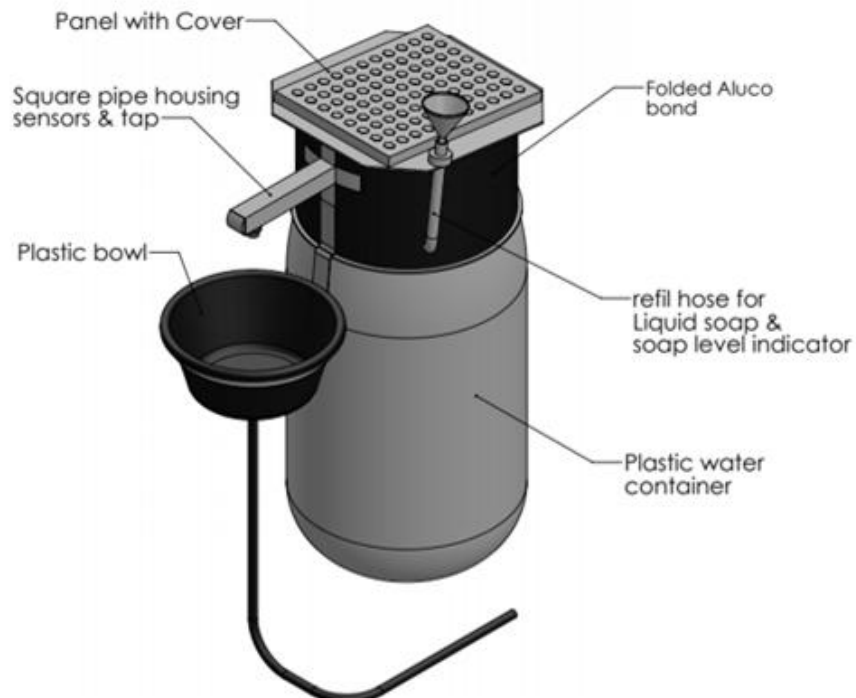
Sensor Synchronizing Soap and Water Dispensing Hand Wash Equipment, called "ELDISMART Hand Wash", is a simple and intelligent hand washing system able to dispense soap and water for users to wash their hands without any human contact with the equipment. The contact-less hand washing system incorporates two submersible pumps and sensors which are not found in conventional hand washing machines. To ensure uninterrupted utilization, the novel system employs solar power as power source. Liquid level indicator sensors for the soap and water are also incorporated to inform the tender to refill as need arises. A cylindrical container serves as the water tank and frame of the invention. A small container of liquid soap is attached at the inside top of the water tank, above the maximum water level. Two submersible pumps respectively inside the soap and water containers are controlled by sensors to release soap and water timely and in succession, as programmed by an electronic circuit. The piping and all electronic components are attached underneath the solar panel which closes the frame.

Figure 1 and 2 above depict the isometric front and rear views of the invention while Figure 6 and 7 give the orthographic and exploded views in that order. The sensors and submersible pumps are shown in Figure 3 and 4 respectively; while the Circuit labelling is depicted in figure 5. Figure 8 is the Flow chart for the machine operation. Once the hand is placed beneath the tap, the sensor actuates the soap pump awhile and then the water pump for the time set. The sensing of the presence of the hand, the metering of soap followed by water for the set periods alongside the sensing and indication of the water and liquid soap levels, are all actuated and synchronized through an electronic circuit consisting: 20W by 12V solar panel, 7.2A/12V backup battery, 12V to 5V dc to dc converter, ATMEGA328P, 0.1 $\mu$ F capacitor, two ultrasonic sensors, two pieces of 22pF capacitors, 16MHz crystal oscillator, 10k $\Omega$ , 1k $\Omega$  resistors, BC337 NPN transistor, a buzzer, two pieces of 5V by10A relays, 2 pieces of 12V dc water pumps, red and green colour LEDs.

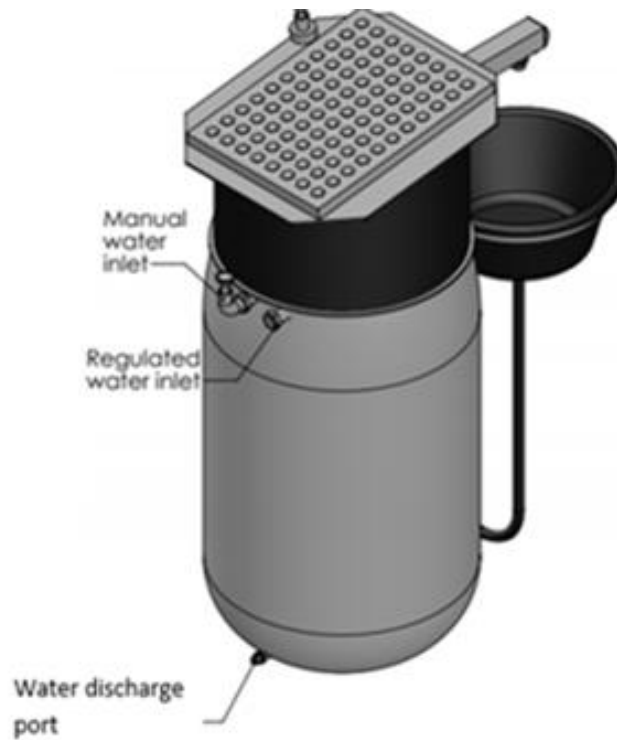
The power supply units consist of solar panel, battery and dc to dc converter. This unit provides the system with 12V and 5V power supply. The microcontroller is activated using the 16MHz crystal and the 22pF capacitors. The transistors and the relays are for switching purpose.

The system first checks the battery voltage, to ensure that it is sufficient to drive it, if the battery level is low; the microcontroller, deactivates the system function, activates the steady red LED and continuous alarm beep. But if battery level is okay, the green LED is activated and then the controller checks the water level. The system is programmed to take note of two water levels; the LOW water level and the LOWEST water level. If the water level is at LOW water level the red LED begins to blink continuously and the alarm is also activated to sound continuously, but the system operation is not deactivated at this point, but once the LOWEST water level is reached, then system function is deactivated until more water is poured into the water container.

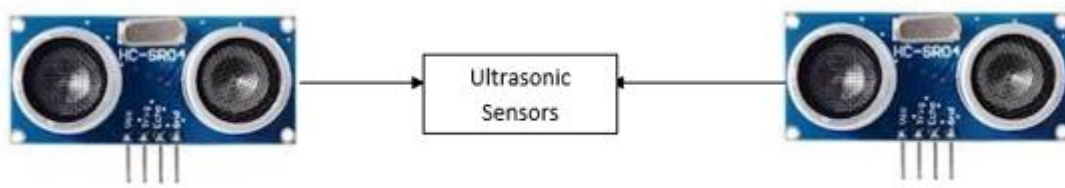
The ultrasonic sensors are used for water level sensing and for sensing the presence of hands. The buzzer beeps twice to indicate that a hand is placed for washing. Once the presence of hands is sensed, the controller activates the alarm beep twice, and then activates the soap pump, to dispense liquid soap, while allowing sometime for proper hand washing, and then activates the water pump for the rinsing of hands. The system waits for 5 seconds and continues with the general system monitoring all over again, it continues with this process until system is switched off.



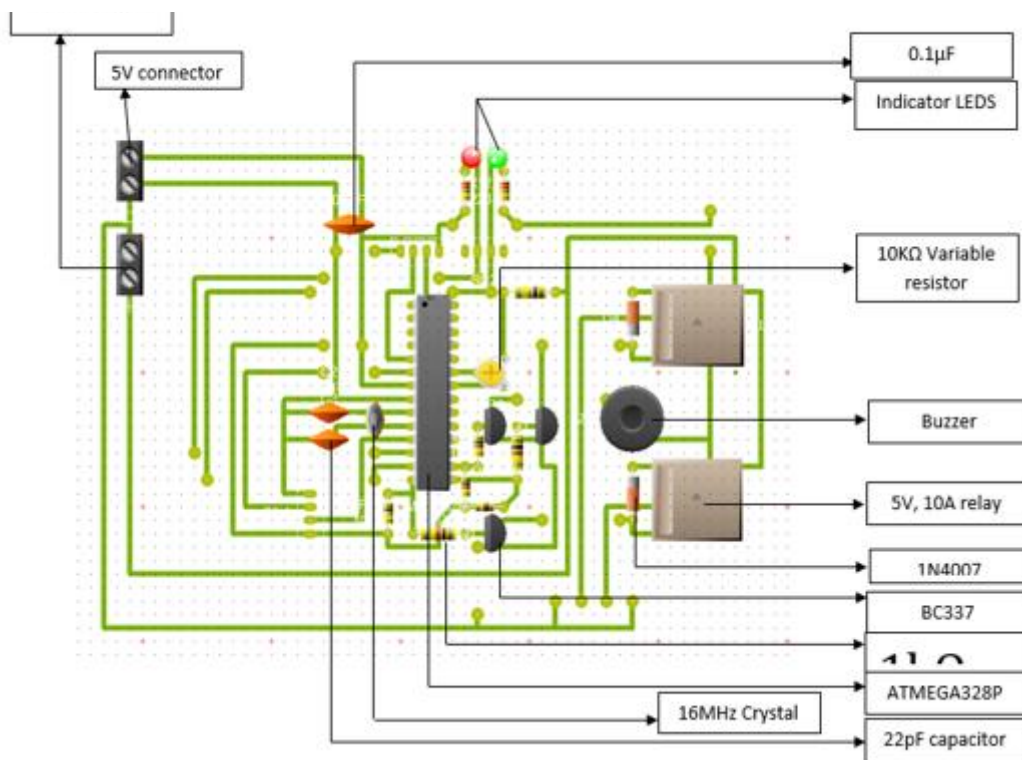
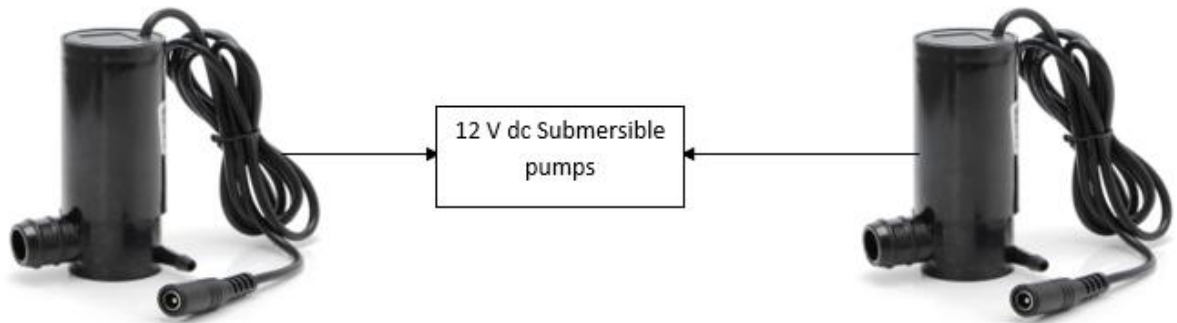
**Figure 2: Isometric front view of Sensor Synchronizing Soap and Water Dispensing Hand wash Equipment**



**Figure 2: Isometric rear view of Sensor Synchronizing Soap and Water Dispensing Hand wash Equipment**



**Figure 3: Ultrasonic Sensors**



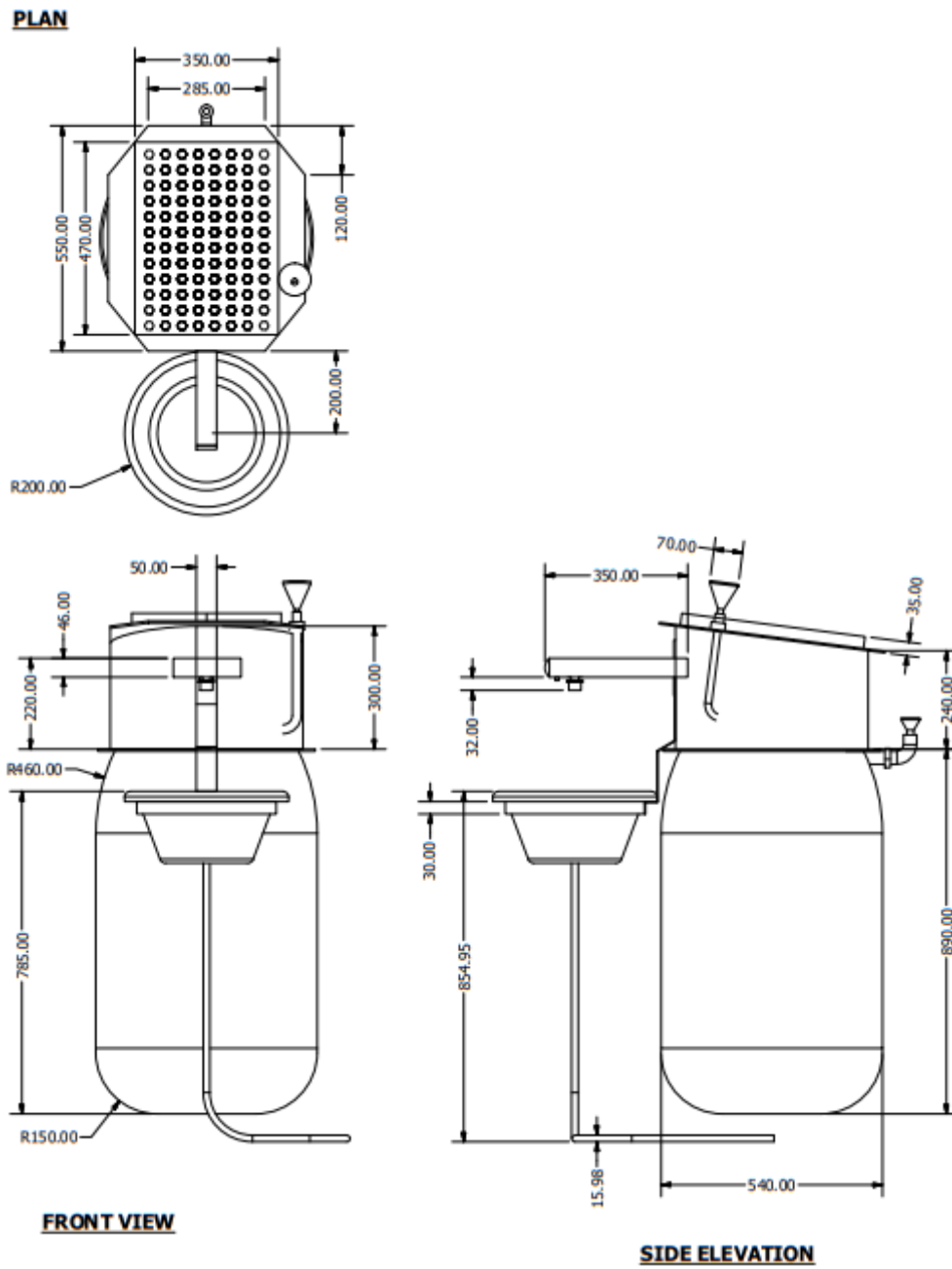
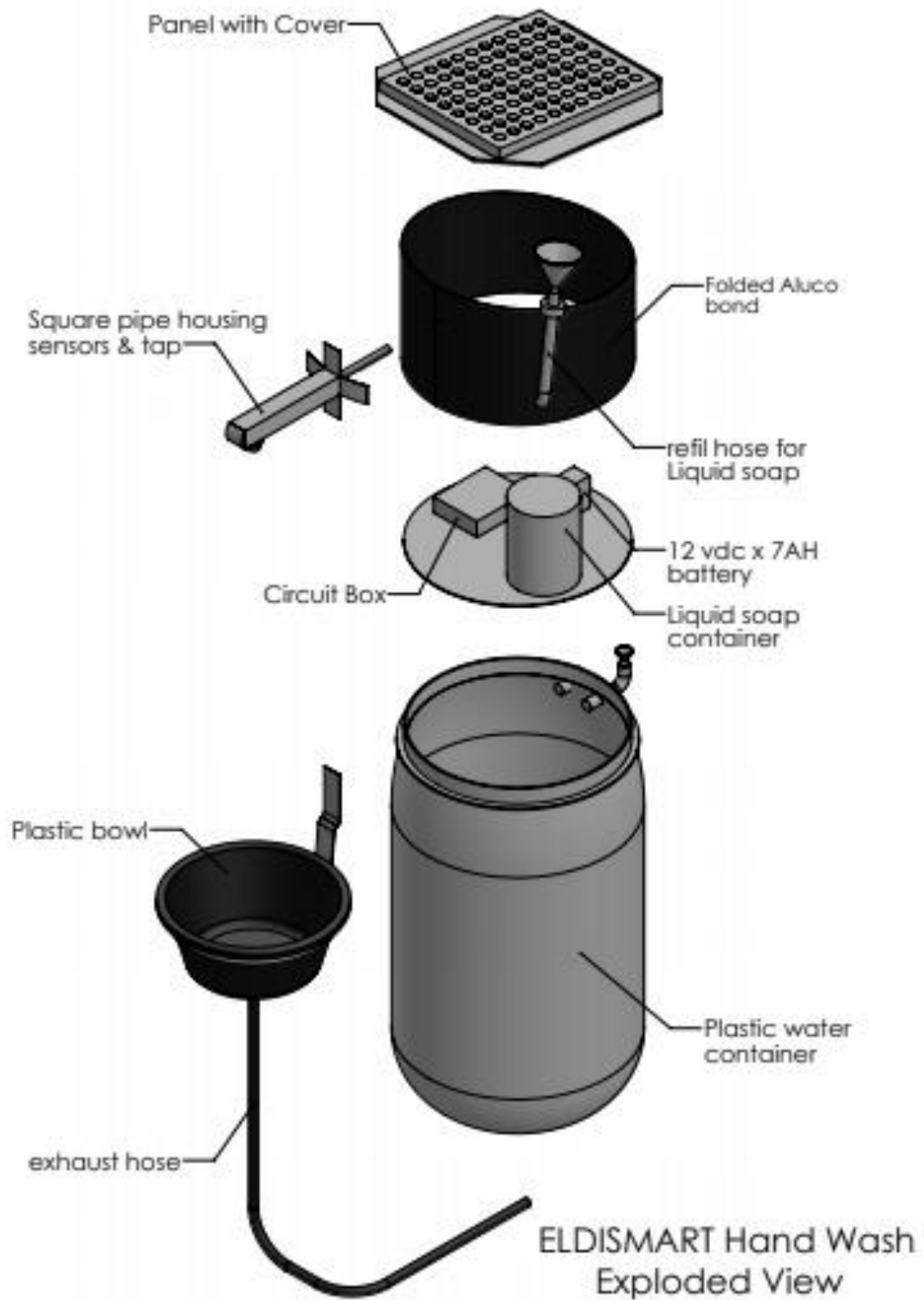


Figure 6: Orthographic view of Sensor Synchronizing Soap and Water Dispensing Hand Wash Equipment



**Figure 7: Exploded view of Sensor Synchronizing Soap and Water Dispensing Hand Wash Equipment**

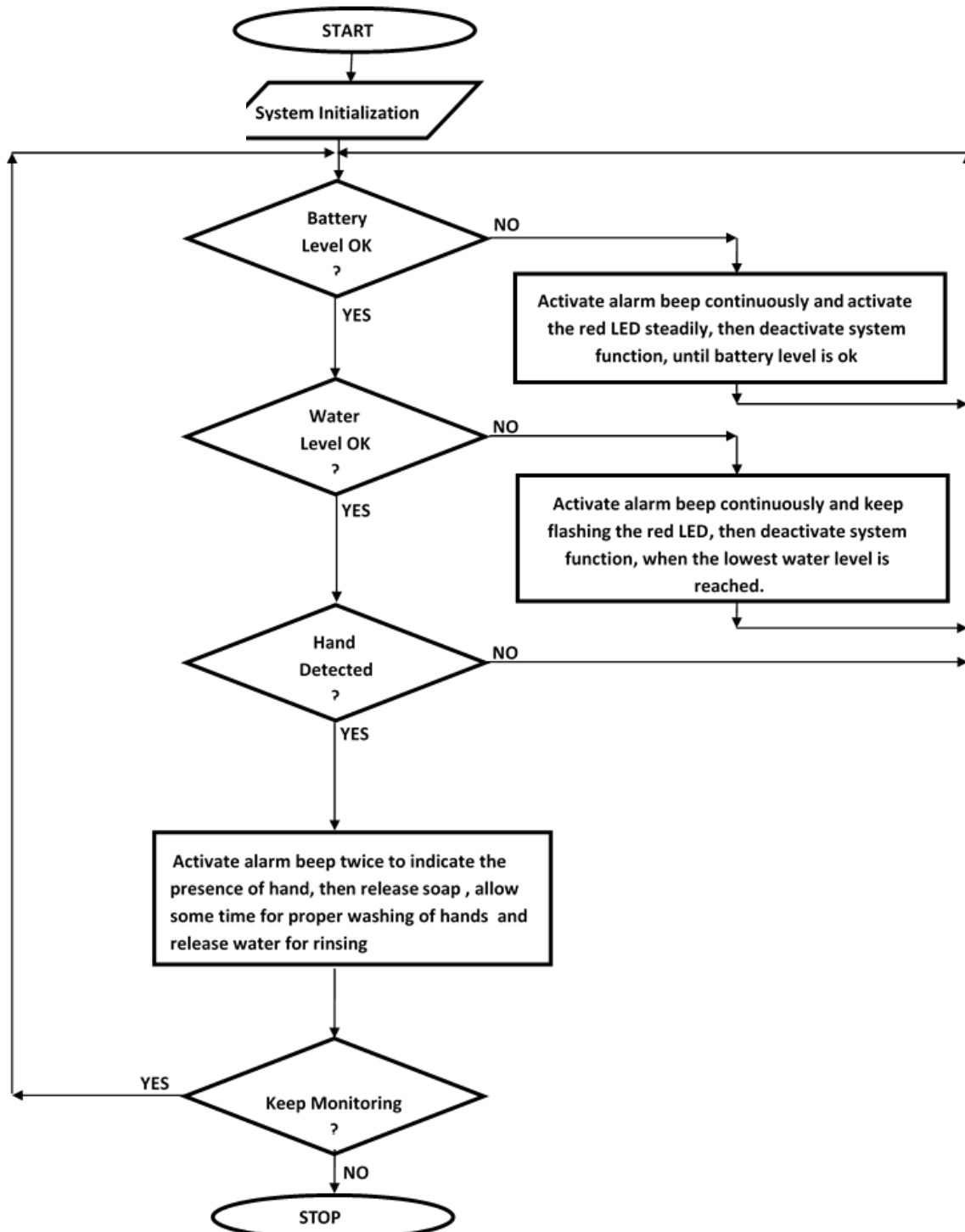


Figure 8: Flow chart for Sensor Synchronizing Soap and Water Dispensing Hand Wash Equipment

### V. Results

Sensor Synchronizing Soap and Water Dispensing Hand Wash Equipment. (ELDISMART Hand Wash) is presented in Plate 5 alongside its important features, specifications and user's instructions.





**Plate 1: Sensor Synchronizing Soap and Water Dispensing Hand Wash Equipment (ELDISMART Hand Wash)**

**Important Features**

- i. Power on switch and LED indicator
- ii. Automatic dispensary of soap and water.
- iii. Smart detection of users' hand.
- iv. Alarm beep on system activation.
- v. Allows appropriate time for proper hand washing in line with the specifications of NDC
- vi. Low battery indicator and alarm
- vii. Continuous alarm beeps on low water level detection.
- viii. Dual power supply system, solar and ac sources
- ix. Regulated and manual water inlet provision.
- x. Visual soap level indicator
- xi. Plastic water container capacity 235litres
- xii. Water discharge port

### **Technical Specifications**

- 1.) Input Voltage DC 12V, 2A.
- 2.) Power rating: 28W
- 3.) Solar panels rating: 20W/ 12V
- 4.) Backup Battery: 7Ah /12V

### **User Instructions**

- 1.) Place your hands under the dispensary outlet
- 2.) Alarm beep, indicates that users' hands have been detected.
- 3.) Liquid Soap will be automatically dispensed then after a while water will be dispensed to rinse hands.
- 4.) Green LED indicates power ON
- 5.) The steady red LED with continuous alarm beeps indicates Low Battery and the system should be switched off under this condition.
- 6.) Blinking red LED with continuous alarm beeps indicates low water level.

### **References**

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