ADVANCED UTENSIL STERILIZATION SYSTEM: AUTOMATED REFILLING AND DRAINAGE FUNCTIONALITY

A Research Paper

Presented to the

Faculty of Senior High School Department

In Partial Fulfillment

of the Requirements for Inquiries, Investigations, and Immersion

By

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Chapter 1
INTRODUCTION

Background of the Study

It is fairly common to use a spoon, fork, and chopsticks to eat food daily. Hence, restaurants and other public eateries typically serve food with these utensils. Afterwards, the utensils are collected back, washed and sterilized with a container of hot water to eliminate harmful pathogens that may cause cross-contamination and risk foodborne illnesses (Neha, 2022). However, once the utensils are taken out and the water cools down to room temperature, the water can be subject to airborne contaminants and develop a biofilm on the container, making it unsuitable for the next sterilization process (Hewes, 2022).

In Nigeria, the primary causes of the high rates of illness and mortality are brought on by poor water sanitation in utensils. Food vendors in Nigeria were sampled for the study using a cross-sectional survey design approach. Over 500,000 deaths resulted from diarrhea due to bad water used for washing utensils and cooking in 2012, over 270,000 deaths due to poor water sanitation and utensil sterilizing. Street food-vending resulting in food poisoning caused by waterborne is a critical problem in many developing communities (Asogwa et al, 2015).

Moreover, in Tuguegarao City, province of Cagayan, a group of researchers conducted a study where water samples collected from buckets of eating utensils were taken to assess the bacterial pathogens present in the water. The water collected was isolated in order for the researchers to identify and count the detection of bacterial pathogens in the water. Results indicate that the majority of the bacteria present in the tested water were Aeromonas sobria, which is considered to be non-pathogenic. Other bacteria isolated were Aeromonas hydrophila and Enterobacter sakazakii, which are non-pathogenic since the colony counts are low (Javier et al., n.d.).

In Malita, Davao Occidental, a study was conducted at the Southern Philippines Agri-Business and Marine and Aquatic School of Technology which involved 93 respondents. It was revealed that they were following sanitary washing practices which include scraping, pre-rinsing, and cleaning utensils in warm water with soap or detergents. However, it did not mention in any way that the utensils were sterilized afterwards with boiling water. It was also agreed among the majority of respondents that washed utensils should be stored in self-draining positions to allow for ready air drying and should be stored in close, dry cabinets free from dust and insects (Chavez, 2023).

The existing research highlights the effectiveness of sterilization, as the method for cleaning in restaurants especially when using new and innovative devices that keep cookware and utensils free from waterborne bacteria. However there is a gap in the understanding of how these modern sterilizing technologies compare to cleaning methods in terms of effectiveness and consumer attitudes. While the benefits of sterilization are recognized, there is research on the outcome's cost effectiveness and overall hygiene implications of using these innovative devices in real world restaurant settings. Filling this gap would provide insights into how to implement these devices helping restaurants adopt efficient and well received cleaning practices that ensure a hygienic dining experience for the customers.

Objectives of the Study

In this research paper we seek to design and create a microwave size drawer to dry and hang clothes in. The researchers are trying to attain the following:

1. Design and develop an Automated Eating Utensil Sterilizer;
2. Test the functionality of the device in terms of draining and refilling; and
3. Revise the defect/s found during the testing process.

Significance of the Study

Individuals. This revolutionary sterilizing device is a game-changer, providing individuals with an electronic solution to effortlessly disinfect their utensils and kitchenware. Tailored for indoor use, especially in public eateries, it leverages cutting-edge technology to ensure optimal hygiene. By integrating this device into daily routines, users can confidently maintain a clean and safe environment, shielding against harmful pathogens with ease.

Restaurants. This groundbreaking invention is a game-changer for businesses, especially in the food industry, ensuring a clean and hygienic dining experience. By focusing on the sterilization of metal spoons and forks in eateries, it not only elevates the overall hygiene standards but also becomes a recognizable symbol for customers. The sterilizing device becomes a testament to the restaurant's commitment to cleanliness, instilling confidence in patrons. It's a win for both businesses, who can showcase their dedication to customer well-being, and customers, who can dine with the assurance of a meticulously sterilized dining environment.

Families. This innovative invention is a boon for families, particularly parents, as it introduces a safer and more efficient solution for mealtime. By providing a secure utensil environment, it not only enhances the overall dining experience for the family but also saves precious time for parents. With this device, parents can enjoy the peace of mind that comes with knowing their loved ones are protected from harmful contaminants, while also streamlining meal preparation and cleanup. It's a win-win for family well-being and convenience.

Future Researchers. This study will help future researchers to acquire the information because finding information on this topic was quite rare and so by distributing this information it will make it simpler for them to research about this topic. Which may lead on to them finding a better solution to the utensil Sterilizer issues that we have found.

Scope and Limitations

This device is designed to sterilize eating utensils such as spoons and forks after they are washed. It functions by eliminating any remaining germs that were not removed during the washing process. The device includes a container with a water heating system, drainage and refilling system, LCD identifier, and UV light for effective bacterial disinfection. Users can place the utensils on a raised mesh strainer inside the container and start the operation by pressing a button. Once activated, the device fills the container with water and heats it up to 149°F (65°C), which is the optimal temperature for killing germs on the utensils. The strainer with the utensils is then lowered into the hot water. The device allows users to control the temperature using a thermostat to accommodate different utensil materials. After five minutes, the utensils are removed from the water using the strainer and dried with the steam generated from the boiling water. The water below is drained once the utensils are dry. Since the device does not have a germ detection system, the water is automatically drained after each process rather than when a germ is detected within the water. Users have the option to stop or continue the sterilization process through the LCD screen. If the latter option is chosen, the UV light secured on the container's lid will begin its own sterilization process within a user-set time limit. To ensure safety, a LED indicator is used to indicate when the UV light is turned on, and the light automatically turns off when the lid is opened. Once the process is complete, users can remove the sterilized utensils at their convenience. Due to the device's limited space, it can only accommodate a smaller amount and size of utensils. Therefore, the researchers are focusing on making the device work efficiently to compensate for the restricted capacity.

Chapter 2

CONCEPTUAL FRAMEWORK

This chapter covers the analysis of the problem, review of related literature and studies, the presentation and discussion of theoretical/conceptual framework, and operational definition of key variables of the study.

Analysis of the Problem

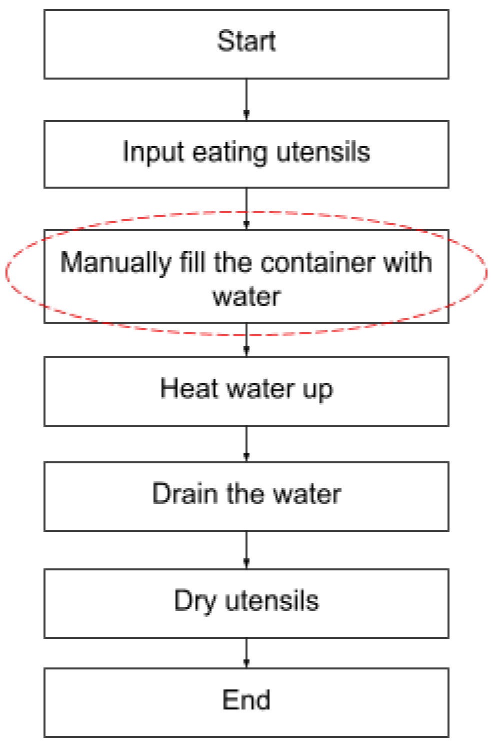

Figure 1. Existing Process Flow

The figure above shows the existing process of sterilizing eating utensils with hot water. The conventional process of manually filling the container with water is tedious and inefficient.

Review of Related Literature

Using utensil sterilizers to stop the spread of waterborne infections requires effective cleaning and disinfection procedures. Researchers assessed how well various sterilization techniques removed waterborne germs from utensils. The results emphasized how crucial it is to follow the right cleaning and disinfection protocols in order to reduce the risk of disease transmission (Rutala & Weber, 2014). Cleaning eating utensils is the main use of boiling water. It is difficult to maintain the water hot enough for extended periods of time; thus, putting water into dining utensils is not a dependable approach to sterilizing them, especially if the water is not constantly immersed in boiling water. When washing dishes, a lot of people try to save boiling water by simply hand-drying the plates. Water contamination could result from this method (Marriott, 2012; J. Engelkirk & P. Engelkirk, 2011).

Waterborne infections in inadequate utensil sterilizers are a major global public health risk because different microorganisms can contaminate water sources and cause illness when consumed. Although the purpose of utensil sterilizers is to keep utensils clean and thus stop the spread of diseases, misuse or poor maintenance of sterilizers might unintentionally lead to the spread of waterborne illnesses. The need for clean water in utensils has grown in importance over the past few years as a result of the world's population and civilization expanding as well as an increase in contamination sources. Numerous aquatic illnesses, such as those linked to microbes or disinfectants, affect millions of people annually. This article provides an overview of water and its potential health effects from several angles. It covers various physical, chemical, and biological contaminants and how consuming contaminated water used to wash utensils may affect a person's body. The efficiency of various drinking water treatment methods, including chlorination, UV radiation treatment, ozonation, heating, and ultra-filtration, in getting rid of various water bacteria, is also covered in the paper. illnesses caused by bacteria, viruses, parasitic protozoa (Allaq et al. 2023).

Insufficient sterilization of utensils facilitates the spread of pathogens, which in turn keeps watery illnesses alive. Plates, glasses, and cutlery are examples of utensils that may contain pathogens from contaminated surfaces or water sources, which might make it easier for people to consume infected food. When microorganisms are not completely eliminated by sterilization techniques like poor washing or inefficient disinfection, the risk of illness rises (Manetu & Karanja, 2021). A study stated that made utensils can be the sources of water contamination by heavy metals, traditional utensils revealed that aluminum pots and clay pots are sources of contamination by heavy metals for people in poor countries who use them daily. Therefore, cooking utensils can be a source of contamination in water by toxic metals (Ojezele et al. 2016). This study is commissioned to address insanitary handling of food in Abia State. It has been studied how simulants, frequent use, washing, and oiling affect the amount of harmful metals released from metallic kitchen utensils, the need to wash with clean water and sanitize the utensils before using. Food hygiene is the discipline of adhering to specific guidelines and protocols to prevent food contamination, maintaining food safety. Several outbreaks of food poisoning and food-borne diseases have been reported in Aba, and these have been attributed mainly to the consumption of food contaminated as a result of compromised food hygiene practices by food handlers (Koo et al, 2020).

Recognising that numerous Oral contact is how infectious diseases are spread, and eating in public As bars are becoming more and more popular, researchers chose to ascertain whether the kitchenware in these places may potentially be regarded as vectors in the transmission of illnesses that travel from mouth to lips. It made sense to think that if numerous germs were discovered during inspection, the dishwashing procedure was inadequate in terms of bactericidal effects due to pathogenic in addition to benign bacteria would endure. Glassware for pouring beer and additional alcoholic drinks are, in a few times, cleaned with hot, soapy water once a day in cold water and washed water at the end of each usage. In the bulk of establishments that dispense alcoholic beverages, data was gathered which usually shows that the glasses are washed with soap and hot water at intervals varying from two to three times weekly (Pamplona et al, 2023).

This study evaluated the sanitization efficacies of manual three-compartment dishwashing processes as a function of washing temperature/time, contaminating organic matter, sanitizing condition, and bacterial type. Ceramic plates, drinking glasses, stainless-steel forks, spoons and knives and plastic serving trays were contaminated with egg, cheese, jelly, lipstick and milk. Each was inoculated with *E. coli* and *L. innocua*. Greater than 5-log bacterial reductions were achieved for all samples after washing at the combination of low washing temperature (24 °C) and minimal sanitizer concentration (150 ppm), except for bacteria on the milk-contaminated regular glasses. The viability of the bacterial species was affected by both organic matter types and the washing water temperature. Although *E. coli* showed better survival when compared with *L. innocua* for jellied utensils, there was no significant difference in survival between them for all other washing conditions. The use of quaternary ammonium compounds had similar killing effects against both bacteria (Borges et al, 2023). In health settings, disinfection and sterilization are crucial biosafety precautions. Chemical deferments are commonly employed as methods to decrease the microbiota in certain settings. ozone and autoclave. It is crucial to emphasize that a large number of the utensils used by medical practitioners are no longer sensitive, making the sterilization process in the autoclave impractical, as stated by the Food and Drug Administration (2018).

Disinfection and sterilization are important biosafety measures used in health environments. The means routinely used to reduce the microbiota in these environments are chemical deferments, autoclave and ozone. It is important to highlight that many of the utensils used by health professionals are not sensitive, leaving the autoclave unfeasible in the sterilization process, regular sanitization and disinfection of surfaces can help avoid bacterial adhesion and contamination (Srey et al, 2013). The main goal of food hygiene is to completely eradicate or significantly lower the chance that people will contract a foodborne illness via improperly cleaned kitchen equipment.

Therefore activities in the kitchen have to be of this that uphold the ideals of food safety and procedures (Matijasevic et al, 2016).

In ordinary home kitchens, some of which are discussed in this succinct overview. Food can become contaminated by microorganisms through a variety of means, including as the hands of the person preparing the food, cooking utensils, and water used in cooking, among others. It is acceptable to state that achieving complete purity in terms of food contamination is exceedingly difficult, if not impossible, given the prevalence of microorganisms and the different ways in which food can get contaminated. Food hygiene and microbiological safety should therefore aim to stop the growth of microorganisms in food rather than completely eradicate them. This will also help to avoid the creation of toxins in food, these include the hands, bodily fluids, or clothes of the person making the meal, filthy cooking tools; dirty cooking water; indoor pets, etc. Anything in the kitchen, whether it be living or dead, that might harbor Microbes that can infect food at any point during preparation could be a source of contamination (Okpala & Ezeonu, 2019). According to the United States Department of Agriculture (2019), cross-contamination is the transfer of harmful bacteria to food from other foods, cutting boards, utensils, etc., if they are not handled properly. This is especially true when handling raw meat, poultry, and seafood, so keep these foods and their juices away from already cooked or ready-to-eat foods and fresh produce.

The Australian Institute of Food claims that Food safety and safety pertain to the handling, preparation, and keeping of food in a way that reduces the possibility of individuals catching foodborne sickness afflictions by adequately sterilizing the kitchen equipment that should be used in a process. Food safety is an international issue that encompasses a wide range of aspects of daily life. This, together with some fundamental concepts of food hygiene and microbiological safety, can be accomplished by kitchen users who have gained a thorough awareness of kitchen components and the microbial hygiene and safety that are linked with them. Used cutlery is cleaned in the kitchen, it is advised that following used cutlery be stored in a thermoset collection pack that comes with a base that resembles a drain tray (Vyas & Kushwaha, 2017).

Prior Art 1

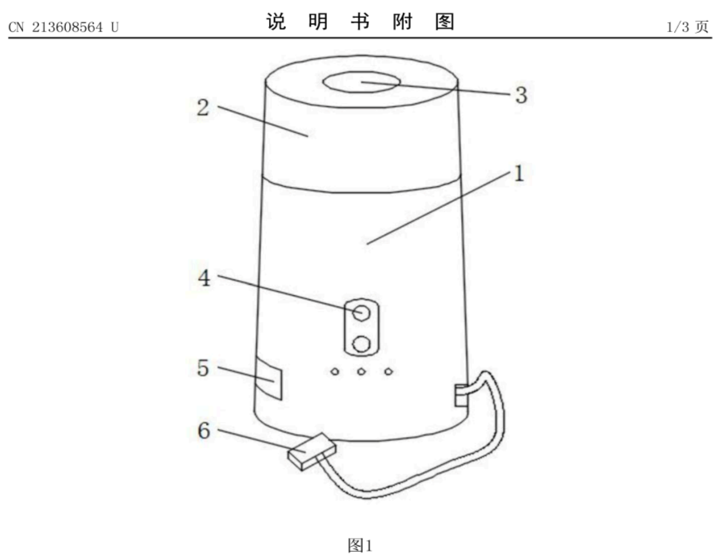

Figure 2. YANG ZETAO, CN213608564U, 2021-07-06, Intelligent Household Small Full Automatic Chopstick Sterilizer.

An intelligent household small full automatic chopstick sterilizer is revealed by the utility model. It consists of an upper cover and a chopstick barrel with a water collecting tank at the lower end and a drying ventilation opening on the inner wall. The chopstick barrel also has an internal draining device that is made up of a connecting rod, a draining plate, a supporting block, and a reserved opening. The chopstick barrel has two reserved apertures carved out of its sidewall. A draining plate is placed inside these openings, a supporting block is positioned at the edge of the draining plate, and a draining hole is created in the center of the draining plate.

Prior Art 2

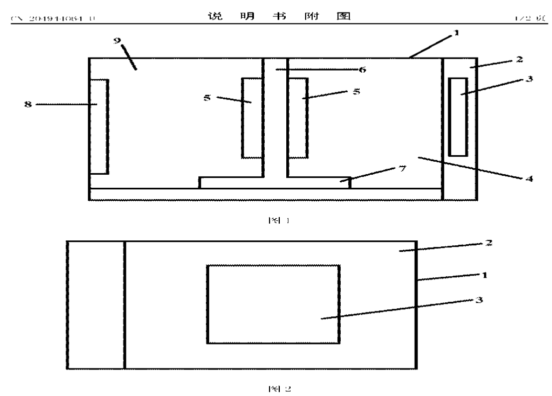

Figure 3. HUANG JINGCHUN; ZHAO WENZHU; LAN RUN, CN204944064U, 2016-01-06, Biomaterial Preparation Household Utensils Sterilization Case.

The utility model relates to a biomaterial preparation household utensils sterilization case, box and chamber door are drawn together to the case and bag of should sterilizing, provided with the drying chamber and go out sterile chamber, drying chamber and go out and be provided with the rotation baffle between the sterile chamber, the drying chamber in be provided with the air outlet, the air outlet is connected with the fan, it is provided with ultraviolet lamp in the sterile chamber to go out. The utility model discloses simple structure, the practicality is strong, carries out automated control through the single chip, with the preparation of the biomaterial behind bone dry household utensils direct rotatory to the sterile chamber that goes out from the drying chamber, less manual operation process, the effectual secondary pollution who avoids biomaterial preparation household utensils, and can be effectual store, dry and sterilize biomaterial preparation household utensils.

Prior Art 3

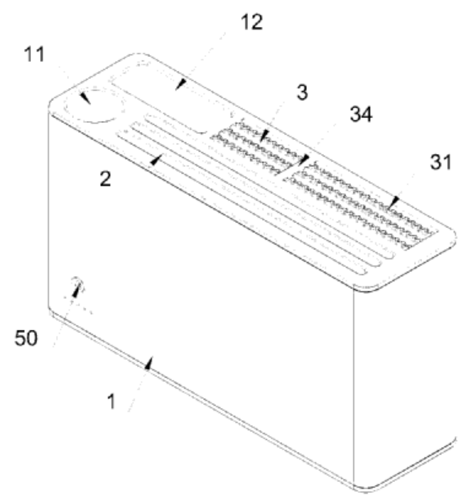

Figure 4. Hu Shihua, CN213911477, 10.08.2021, Kitchen Utensil Sterilizer

The kitchen utensil sterilizer is characterized in that the kitchen utensil sterilizer comprises a box body and a containing cavity formed in the box body, the interior of the box body is hollow, the containing cavity is used for containing chopsticks, a containing cavity used for containing a chopping board and an insertion cavity used for containing cutters are further formed in the box body, and the containing cavity is communicated with the containing cavity. A sterilizing lamp and an air exhaust device are arranged below the box body, the sterilizing lamp and the air exhaust device are connected through the same control switch, a heater is further arranged on the side face of the air exhaust device, and the air exhaust device is used for driving hot air to circulate. Therefore, bacteria are prevented from harming human bodies.

Synthesis

The prior art of sterilizing utensils using boiling and draining methods is tedious and potentially unsafe due to the presence of bacterial spores like clostridium and bacillus as stated by the Department of Health (2023). These spores can survive boiling conditions, potentially contaminating the next batch of utensils and not fully sterilizing the current one. The device's only use of water for sterilization further exacerbates these issues.

Features	**Proposal**	**D1**	**D2**	**D3**
	Automated Eating Utensil Sterilizer	Intelligent Household Small Full Automatic Chopstick Sterilizer	Biomaterial Preparation Household Utensils Sterilization Case	Kitchen Utensil Sterilizer
Water Heating	✓	✓	X	X
Drying	✓	✓	✓	X
Automated Draining	✓	✓	X	X
UV Light	✓	X	✓	✓
Adjustable Temperature	✓	X	X	X
Automated	✓	X	X	X

Features	**Proposal**	**D1**	**D2**	**D3**
	Automated Eating Utensil Sterilizer	Intelligent Household Small Full Automatic Chopstick Sterilizer	Biomaterial Preparation Household Utensils Sterilization Case	Kitchen Utensil Sterilizer
Water Heating	✓	✓	X	X
Drying	✓	✓	✓	X
Automated Draining	✓	✓	X	X
UV Light	✓	X	✓	✓
Adjustable Temperature	✓	X	X	X
Replenishing				

Table 1 shows the similarities and the difference of prior art in terms of technology used.

Conceptual Model

This section shows how the study generated concepts, the inputs to be applied and plans to be constructed. The conceptual framework presented the three components: the input, the process, and the output. The input shows the ideas, related literature and studies, supplies and materials needed, tools and equipment, and labor. The process phase shows the designing and constructing of the device, creating and interfacing the software and hardware parts of the device, and testing and revising some defects of the machine. The output of the study is the complete and functional automated eating utensil sterilizer.

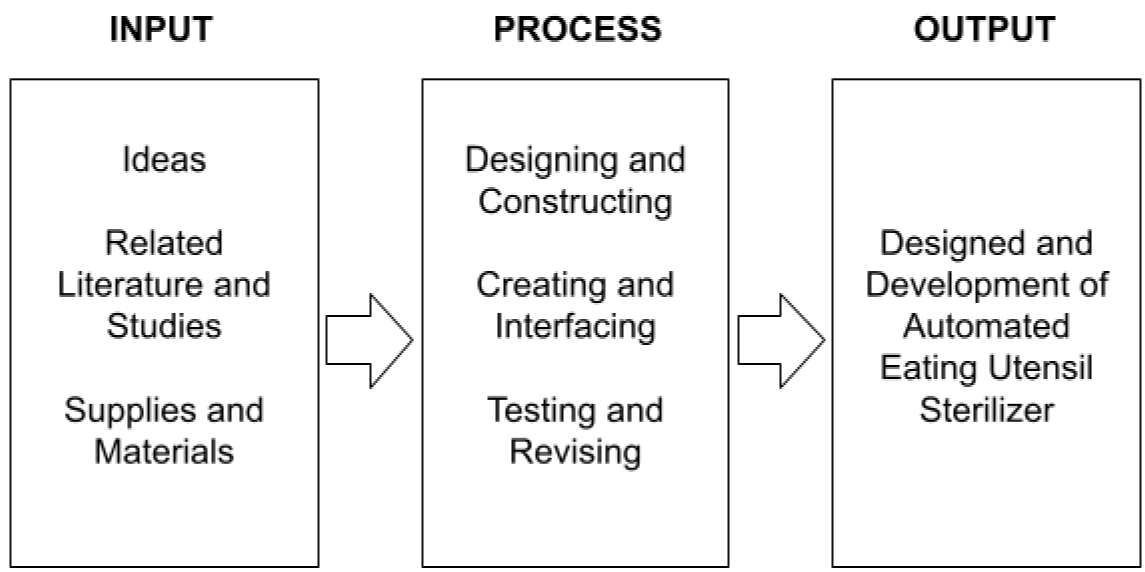

Figure 5. Research Paradigm

Operational Definition of Terms

Terms that are defined here are the words commonly used throughout the project. Such terms are:

Container	It is a xxx inches stainless steel container utilized to store and sterilize eating utensils inside
Heating Element	This is responsible for heating the water up
Thermostat	To control the heat that the heating element emits.
Insulator	This is to retain the heat of water when used for sterilization.
UV Light	Used to add an extra layer of sterilization for eating utensils after they are submerged in hot water.

Mesh Strainer	This is responsible for holding and separating the eating utensils from the water.
Pulleys	These are attached to the mesh strainer and are connected to the motor in order to lower and raise the strainer to and from the water.
Electric Motor	It is connected to the pulleys to level the strainer up and down.
Microcontroller	This is responsible for interfacing the UV light sterilization option and the adjusting of the temperature system of the device.
LED	Used to indicate whether the UV light is turned on or off inside the container.
LCD Screen	Used to display the timer for the UV light exposure and hot water submerging. It is also used to allow the users to stop or continue with the sterilization process.
Magnetic reed switch	To sense when the lid is opened so the device can automatically turn off the UV light
Water Pump	Used to transfer water to the opposite side of the device.

Chapter 3

DEVELOPMENT AND EVALUATION OF THE PROJECT

This chapter presents the project plan, supplies and materials needed for the project, and equipment needed on this project study.

Design Phase

This section provides the Project Plan, Process Flow of the project, Concept Designs with Dimensions and Calculations, Supplies and Materials, Tools, Instruments and Equipments required for constructing the project.

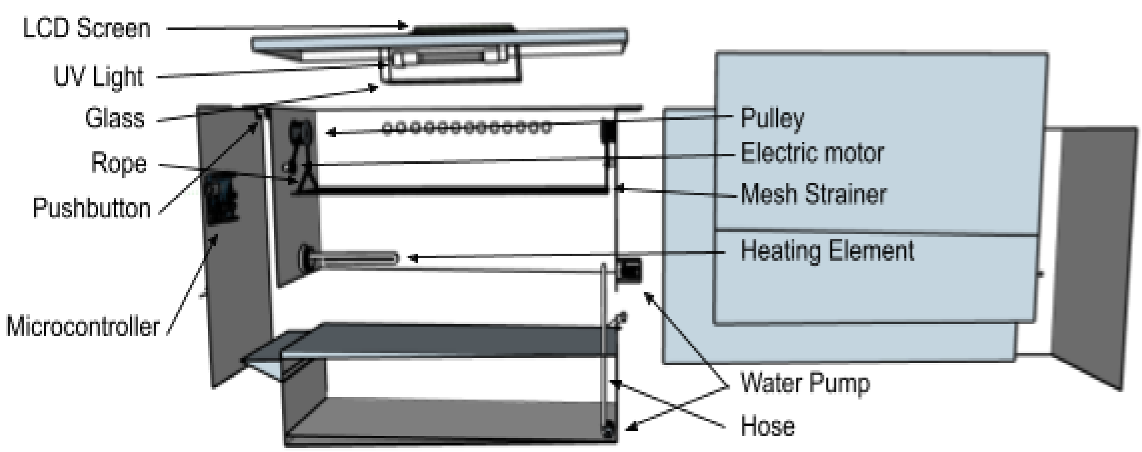

Figure 6. Exploded View of the Automated Eating Utensil Sterilizer

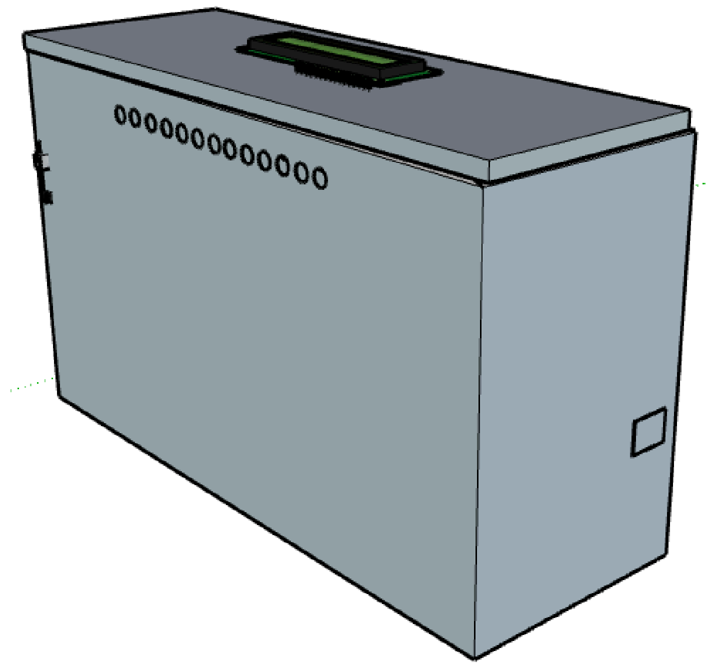

Figure 7. Isometric View of the Automated Eating Utensil Sterilizer

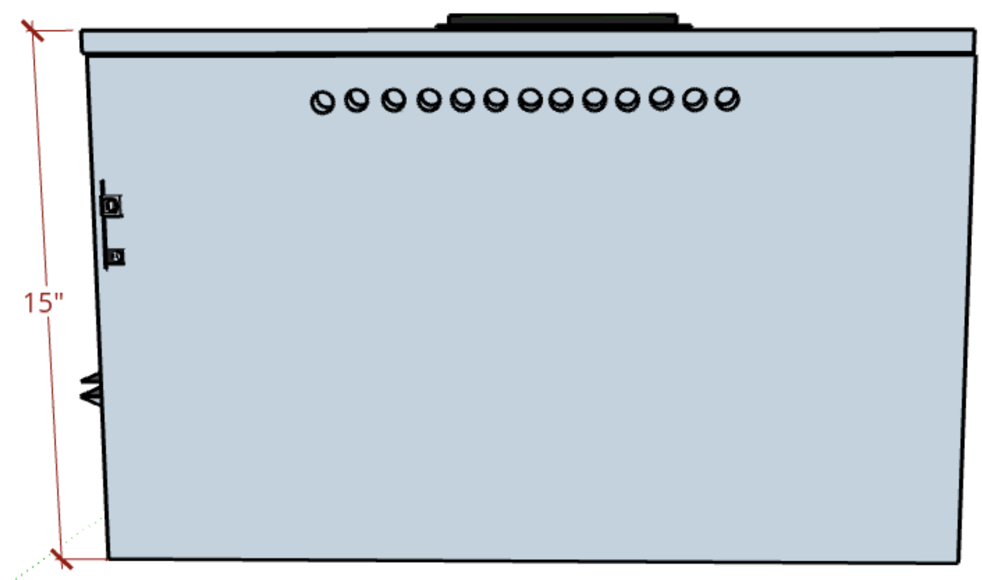

Figure 8. Front View of the Automated Eating Utensil Sterilizer

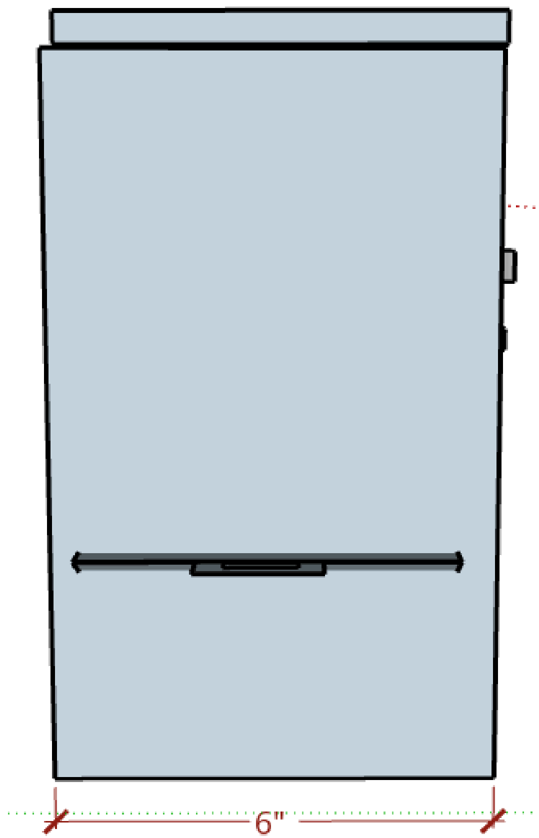

Figure 9. Side View of the Automated Eating Utensil Sterilizer

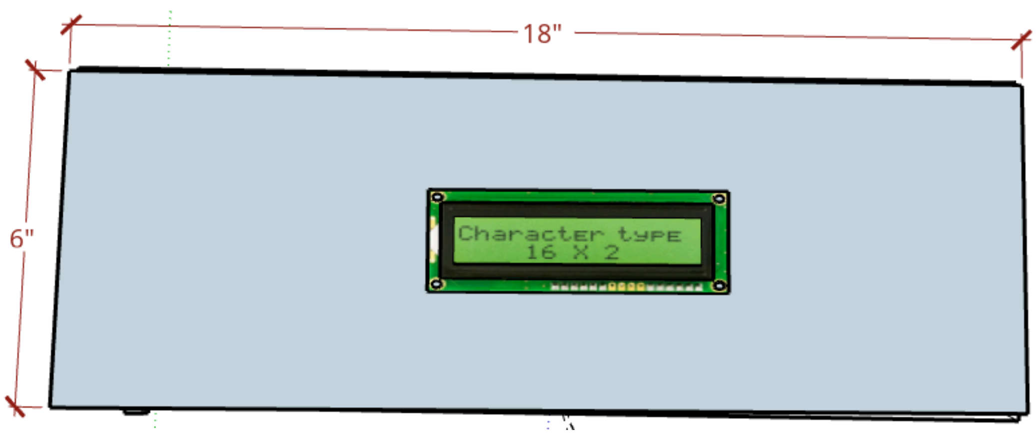

Figure 10. Top View of the Automated Eating Utensil Sterilizer

New Process Flow

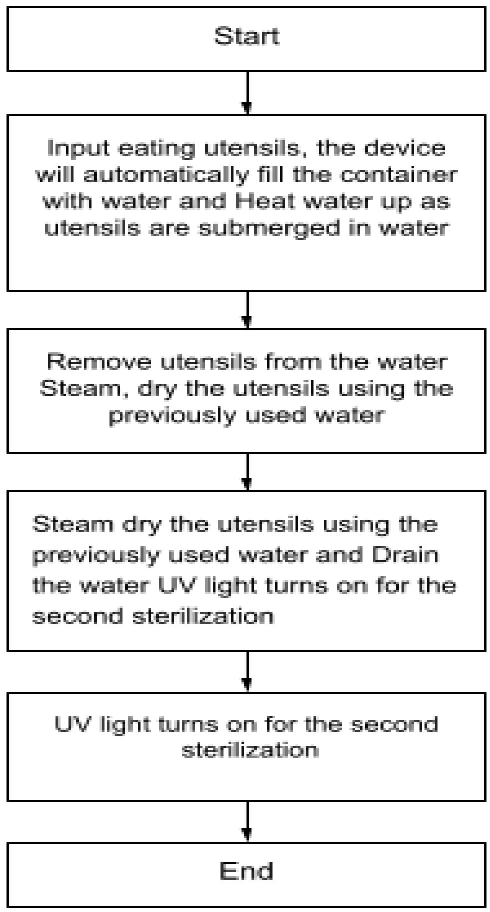

Figure 13. The new process flow

Figure 13 shows the new process flow of the device. The eating utensils are to be placed on the mesh tray that will be lowered as the process starts. The device will automatically fill the container with water from another chamber, the water will then be heated for the first sterilization process. The temperature of the water will be controlled by a thermostat. Afterwards, the tray will be elevated up from the water, the water will be turned in its boiling point to steam dry the utensils. The water will then be drained through the water pump while the UV light begins to sterilize the eating utensils. Once done, the utensils can remain inside the container or placed somewhere else clean.

Supplies and Materials

This section shows the supplies and materials that will be used in the conduct of the study.

Quantity	Unit	Description
1	Pc.	Arduino uno
2	Pcs.	pulleys
2	Pcs.	electric motor
1	Pc.	microcontroller
2	Pcs.	LED
1	Pc.	LED Screen
6	Pcs.	stainless steel
1	Pc.	Heating Element
1	Pc.	Thermostat
1	Pc.	UV light
1	Pc.	Mesh Strainer
2	Pcs.	Water pump
8	mm.	Hose

Table 1. Supplies and Materials

Table 1 shows the list of supplies and materials with their respective quantities, units, and descriptions. These supplies and materials will be used for the fabrication of the assembly.

Tools and Equipment

This section shows the tools and equipment that will be used in the conduct of the study.

Tools and equipment	Function
Philip screwdriver	A tool for turning (driving or removing) screws.
Metal saw	A hand power tool used to cut hard material.
Screw	A tool used to join things together by being rotated so that it pierces steel or other material and is held tightly in place.
Steel Tape	A tape of steel marked off in a linear scale, as of inches or centimeters, for taking measurements.
Welding	A tool that provides power and the parts to generate the heat that melts materials.

Table 2. List of the Tools Used on the Device

Table 2 shows the tools which were used in the project together with their functions.

Instruments	Function

Arduino uno	Used to general purpose I/O
Digital Multimeter	. Used to test faulty cable/continuity

Table 3. List of Instruments Used on the Device

Table 3 shows the list of instruments that were used in the project together with their functions.

Instruments	Function
Computer	A machine that can store and work with large amounts of information.

Table 4. Equipment Used on the Device

Table 4 shows the list of equipment that were used in the project with their functions.

Project Cost

This section shows the total cost of the proposed project including the supplies & materials and overall project cost.

Quantity	Unit	Description	Unit cost(Php)
1	Pc.	Arduino uno	459.00

2	Pcs.	pulleys	390.00
2	Pcs.	electric motor	358.00
1	Pc.	microcontroller	459.00
2	Pcs.	LED	8.00
1	Pc.	LED Screen	365.00
6	Pcs.	stainless steel	330.00
1	Pc.	Heating Element	99.00
1	Pc.	Thermostat	249.00
1	Pc.	UV light	328.00
1	Pc.	Mesh Strainer	85.00
2	Pcs.	Water pump	370.00
8	mm.	Hose	45.00
		Total	**3,545**

Table 6. Cost of Materials and Equipment

Table 6 shows the cost of materials and equipment used to create the project. The currency unit used for the prices above is in Peso (Php.).

Chapter 4

RESULTS & DISCUSSION OF EVALUATION AND DESCRIPTION OF THE COMPLETED PROJECT

This chapter presents the results and discussion of project evaluation.

Results & Discussion of Project Evaluation

Presentation of Data

The tables below show the evaluation of the respondents in terms of the project's functionality.

Table 8

No.	Items	Mean	Description
		Teachers	
1.	The heating element can functionally boil water.	4	Highly Functional
2.	The heating element will automatically turn off after the given time frame.	3.6	Highly Functional
3.	The device's motor can lower	3.7	Highly

	the strainer down onto the water upon starting.		Functional
4.	The device's motor can lift the strainer on time.	3.5	Highly Functional
5.	The UV light automatically turns on after the utensils are steam-dried.	4	Highly Functional
6.	The UV light automatically turns off when the lid is open.	3.9	Highly Functional
7.	The LCD screen shows the individual timer for each process.	4	Highly Functional
8.	The LCD screen tells the user when the utensils are free to be taken out.	4	Highly Functional
9.	The water pump can pump water from the reserve storage into the sterilizing chamber.	4	Highly Functional
10.	The water pump can pump	3.9	Highly

	out water to drain when the assigned time is met.		Functional
	TOTAL	**3.86**	**Highly Functional**

Analysis & Interpretation of Data

As presented on table 8, it can be said that the project, Automated Eating Utensil Sterilizer, is Highly Functional, with a mean of 3.86 as rated by 10 teachers.

Findings of the Study

Based on the result, the Teachers who are experts and non-experts in the field have evaluated the project's functionality as Highly Functional.

Structure of the Project

Parts, Functions and Interrelationship

1. Parts of the machine and their function

   The project is composed of several parts with different sets of specifications. The scope of its specification depends on the performance required of the parts. The written requirement as to the role of the component parts was very important to ensure that the finished subassembly is performed as intended. Presented in table 9 are the parts and their functions in the project.

Table 9

Parts and Functions of the Project

Parts	Functions
Heating Element	Responsible for heating the water up.
LCD	Used to display the timer for the UV light exposure and hot water submerging. It is also used to allow the users to stop or continue with the sterilization process.
Servo Motor	It is connected to the pulleys to level the strainer up and down.
Water Pump	Used to refill and drain the water in the container.
UV light	Used to add an extra layer of sterilization for eating utensils after they are submerged in hot water.

2. Interrelationship

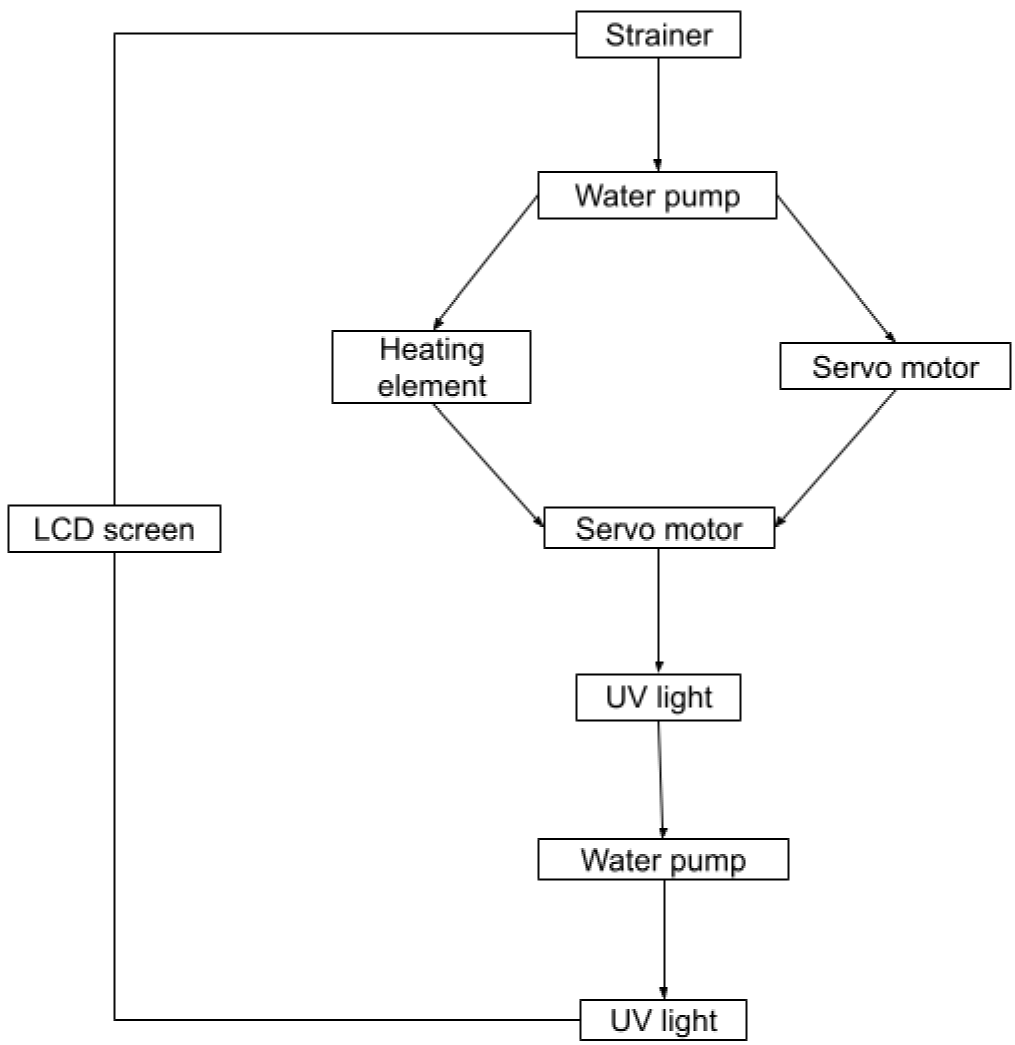

Figure 13. Interrelationship

Capabilities

The Automated Eating Utensil Sterilizer is capable of performing the following operations:

1. The heating element can boil the water.
2. The water pump can refill and drain the container.
3. The project can sterilize the utensils.
4. It can be used by whoever.
5. Can handle a small group of utensils like spoon and fork.

Limitations

1. Does not have a container for the drained water.
2. Does not sterilize a large capacity of eating utensils.
3. Researchers do not recommend plastic utensils to be sterilized due chances of deformation in high temperature.

Features/Specifications/Technical Effect

The following are the features of the project.

1. Heating Element. Responsible for heating the water up.
2. Servo Motor. Used to pull the strainer up and down.
3. LCD screen. Used to display the process and its timer.
4. UV light. Used to add another layer of sterilization.
5. Water pump. Used to pump water in and out of the container.

Process

This section presents the operating procedures, maintenance and safety and control measures.

Operating Procedures

The following steps are needed to operate the project

Step 1. Get the Automated Eating Utensils Sterilizer .

For Sterilizing	*For Taking the Eating Utensils*
Step 2. Place the eating utensils on the strainer.	**Step 2.** After the process, get the cooled down eating utensils in the container .
Step 3. Push the button to start the sterilization and wait for its process to end.	**Step 3.** After getting all the utensils, close the sterilizing container.

1. Sterilizing container being filled with eating utensils.
2. To prevent damage when exposed to rain, it shouldn't be placed outdoors.
3. Keep young children away from the device to avoid playing with them.
4. In order to prevent a power supply shortage while it is sterilizing, check the socket regularly or every week.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter will provide a summary of the purpose. Conclusions will be discussed based on researcher insights gained regarding study findings and limitations. It concludes the recommendation.

Summary of Findings

The project study entitled “Automated Eating Utensils Sterilizer” was created to provide solutions to the existing problems of present inadequate sterilization. In the conduct of the study , it was found out that the project is highly functional as perceived by teachers with knowledge on the matter.

Specifically, the highest rating of all the items in functionality are items 1, 5, 7, 8 and 9 with 4.0 rating, described as highly functional. Next to them are items 6 and 10 with 3.9, also described as highly functional. The sole lowest rating is item 4 with a mean rating of 3.5, still highly functional.

Conclusions

Based on the findings of the study, it was concluded that the Automated Eating Utensil Sterilizer is highly functional and highly efficient. Moreover, the sterilizer can be used for surgical utensils and not just for eating. The boiling method, the steam drying, as well as the UV light gives a triple-layered sterilization.

Recommendations

Based on the findings of the study, the following recommendations are deemed appropriate:

1. The project's capacity should be improved to cater to a larger amount of eating utensils.
2. The project should be designed in a way that it can be more appealing.
3. There should be a buzzer to notify users when the process is done.
4. Install a biosensor that detects germs in the water to ensure sterility.
5. Conduct further study to improve the existing project.

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