

Design of new products for kitchenware washing

Diseño de nuevos productos para el lavado de utensilios de cocina

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Abstract

This work shows the research of users' needs and motion-timing data to design and develop new series of products to help in kitchenware washing. The research was performed by students and professors of the industrial engineering program of the Universidad Tecnológica del Valle de Toluca (UTVT), Mexico and the results will be used by mechatronics students of this University to develop new products for home and office. At the beginning, an Ishikawa diagram is presented to identify the main causes related to the need of kitchenware washing like excessive time, manual handling and water waste. A benchmarking of dish washer machines for home and industry is included, attending cost, power consumption and speed. The method used to perform the research is the user's needs and includes a diagram process of washing, surveys, interpretation and hierarchy of needs. The motion timing data was obtained by the recording and study of videos of users of different profiles. The main kitchenware in the washing process was obtained too. Finally, the conclusions and the main characteristics for new products and their impact are presented. Currently, the mechatronics students are generating concepts and validating their functionality

Resumen

Este trabajo muestra la investigación de las necesidades de los usuarios y los datos de tiempo de movimiento para diseñar y desarrollar nuevas series de productos para ayudar en el lavado de los utensilios de cocina. La investigación fue realizada por estudiantes y profesores del programa de ingeniería industrial de la Universidad Tecnológica del Valle de Toluca (UTVT), México, y los estudiantes de mecatrónica de esta universidad utilizarán los resultados para desarrollar nuevos productos para el hogar y la oficina. Al principio, se presenta un diagrama de Ishikawa para identificar las principales causas relacionadas con la necesidad de lavar los utensilios de cocina, como el tiempo excesivo, la manipulación manual y el desperdicio de agua. Se incluye una evaluación comparativa de las máquinas lavaplatos para el hogar y la industria, que incluyen el costo, el consumo de energía y la velocidad. El método utilizado para realizar la investigación es la necesidad del usuario e incluye un proceso de diagrama de lavado, encuestas, interpretación y jerarquía de necesidades. Los datos de tiempo de movimiento se obtuvieron mediante la grabación y el estudio de videos de usuarios de diferentes perfiles. También se obtuvieron los principales utensilios de cocina en el proceso de lavado. Finalmente, se presentan las conclusiones y las principales características de los nuevos productos y su impacto. Actualmente, los estudiantes de mecatrónica están generando conceptos y validando su funcionalidad.

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Introduction

There is an increasing need to keep kitchenware clean in the food making process, this is an essential requirement in houses, restaurants and other establishments which prepare and sell food. Such need has been dealt with through hand and special machine washing; however, these measures have not been convenient due to the time they require and other resources like water and detergent. Figure 1 shows an Ishikawa chart with the main problems involved in the kitchenware washing in any context.

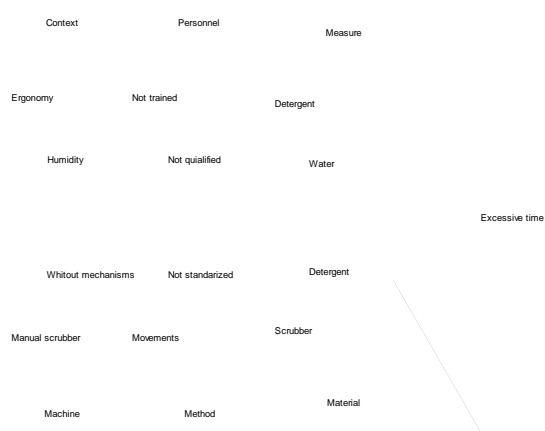


Figure 1 Cause and effect diagram

Objective

It is for these reasons that the objective of this paper is to identify the areas of improvement in the kitchenware washing process through tools of quality and the work study to define the characteristics and qualities of a new product that will help to reduce the time used in this process.

Nomenclature

Kitchenware: Objects used to cook, eat and drink, such as pottery and cutlery.

Benchmarking

First, some information gathered from suppliers, catalogs and online sites was analyzed, then the characteristics of a five-object sample were compared regardless its industrial or domestic use to select the key aspects of each one, these aspects are production speed, duty cycle, water and energy consumption as shown in table 1.

Product	Production (baskets/hour)	Cycle's time (s)	Consumption (L)	Power (KW)
Kitchenwarewasher	30/15/10	120 /240/ 360	5.0	11.2
Glasswasher	30	120/ 300	2.3 / 2.0	Not founded
Dishwasher	60/20/30	60/ 120/ 180	3.5	7.5
Bottle washer	30,000 to 120,000	Not Founded /	/	Not Founded
Washing line	112/168	Not Founded //	390	30

Table 1 Comparison between washing equipment

Kitchenware washing process

Some steps are needed in the kitchenware washing process to ensure a good dish cleaning, that is why a diagram with the hand kitchenware washing process is shown in figure 2. This diagram is based on the IDEF 0 method and highlights the inputs, outputs, controls and mechanisms involved in each step of the process.

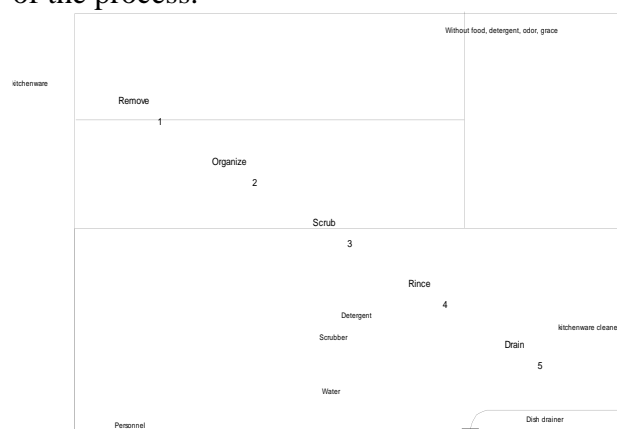


Figure 2 IDEF of the kitchenware washing process

Categorization

To count the number of utensils in a household kitchen involved in the washing process correctly, the objects were divided in five categories according to their shape. This categorization involves all the kitchenware, from the smallest such as spoons and knives, to pots and pans as shown in the following list

1. Cutlery
2. Dishes
3. Glasses
4. Pots and pans
5. Accesories

– Cutlery refers to spoons, forks and knives.

- Dishes: Dinner plates, soup plates and bowls
- Glasses: Cups, glasses, wine glasses and mugs.
- Pots and pans: some big objects such as trays and tea pots
- Accessories refer to ladles, turners and lids.

Survey application

Figure 3 shows the questions of a survey that was carried out in order to identify the areas of improvement that will help to define a new kitchenware washing product, this was taken by people with different profiles such as housewives, employees, bachelors and students to identify users' needs as suggested by Ulrich & Eppinger [1].

Name: _____
 Age: _____
 Occupation _____

1. What do you like about washing the dishes?

2. What don't you like about washing the dishes?

3. What do you propose to improve washing the dishes, less time and easier?

4. How long does it take to wash the dishes and how often?

5. Can I watch and film how you wash the dishes?

Figure 3 Survey. Original version in spanish in Anex A.

Interpretation of needs

The qualities of the new product were the result of the interpretation of the answers from the survey. Once the ideas were identified and grouped, the ones that did not provide relevant information for the new product were discarded and the rest were grouped based on the times they were given as answers. Table 2 shows the interpretation and frequency of needs

Interpreted need	Frecuency
The product helps to remove grease and leftovers by soaking the kitchenware in hot water	10
The product can wash bulky utensils	5
The product can wash small utensils	4
The product works automatically	4
The product rinses utensils with little water	2
The product works quickly	1
The product occupies a reduced space	1
The product selects the utensils according to their size	1
The product uses effective detergents	1

Table 2 Interpretation of needs summarized

Reviewing of videos

Each person who answered the survey was filmed while washing their dishes. This allowed recording the kitchenware washing process in different contexts to analyze the users' habits, figure 4.



Figure 4 Videos

The data of the amount of utensils and the average time used to wash them was obtained by analyzing the videos. Table 3 shows a hierarchy of the categories with the most impact in the process.

Category	Q	%	Time (s)	%	Average (s/unit)
Cutlery	113	43.62	538	19.83	4.76
Dishes	83	32.04	1245	45.89	15
Glasses/ Cups	37	14.28	460	16.95	12.43
Pots and pans	9	3.47	230	8.47	25.55
Accesories	17	6.56	240	8.84	14.11
Total	259	100	2713	100	71.85

Table 3 Summarized data of the video results

Motion timing study

Cutlery and dishes are the categories with most quantity of objects and time spent in washing. These results led to carry out a motion timing study to obtain the most time consuming tasks. This information is of high importance because it allows us to achieve the objective of this project. Figure 5 shows a chart that simplifies the standard time used in each part of the kitchenware washing process. As we can observe, the activities that require the most of time are the dish and cutlery scrubbing and stacking. An example of the motion timing study is showed in Appendix B.

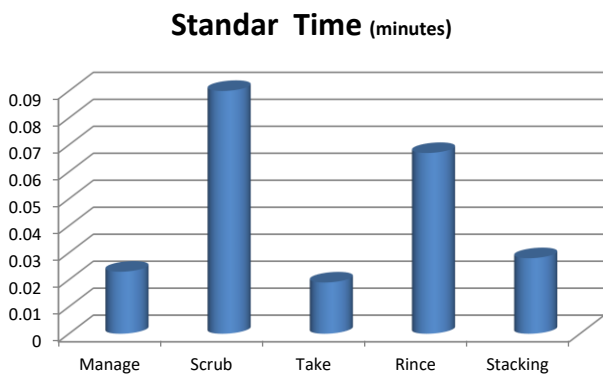


Figure 5 Summary on the motion timing study

Product Definition

With the results from the interpretation of needs and the motion timing study it was possible to obtain the following table which shows the different functions of products aimed to clean dishes and cutlery.

Quantity		40%	20%
Time	Characteristic	Dishes	Cutlery
40% 30%	Removes grease and leftovers by soaking the kitchenware in hot water	Y	Y
	Washes bulky utensils	N	N
	Washes small utensils	N	N
	Scrubs automatically	Y	Y
	Rinses automatically	Y	Y

Table 4 .Summary of the functions of the cleaning products

Seventeen viable products were found from the different combinations of table 4. However, dish and cutlery grease removal does not impact the products, because it is not that important as it is for pots and pans, that is why the potential options were reduced to seven. These options are shown in table 5.

Possible viable products	Impact to reduce the time in kitchenware washing process
The product scrubs and rinses dishes and cutlery automatically	42%
The product scrubs dishes and cutlery automatically	24%
The product rinses dishes and cutlery automatically	18%
The products scrubs dishes automatically	16%
The product rinses dishes automatically	12%
The product scrubs cutlery automatically	8%
The product rinses cutlery automatically	6%

Table 5 Possible viable products

The product that scrubs and rinses dishes and cutlery automatically was discarded because according to the benchmarking, three of the five devices have already covered such need, therefore, it will have more competitors. For all of the above, the five most important potential characteristics of kitchenware washing products to develop are:

The product scrubs dishes and cutlery automatically: 24%

- The products scrubs dishes automatically: 16%
- The product rinses dishes automatically: 12%
- The product scrubs cutlery automatically: 8%
- The product rinses cutlery automatically: 6%

Application

As we saw in the previos section, the most important chracteristic of the product is to scrub dishes and cuttlery automatically. This can reduce by 24% the time spent in the kitchenware washing (Table 5). For this reason, in this section the development of a new product will be shown. The first step was a brainstorming and its evaluation according to its viability. Table 6 shows the matrix of evaluation.

Main object	Useful for dishes and cutlery	Time	Size	Remove left overs	Total
conveyor+scrubber	Reference	Ref.	Ref.	Ref.	Ref.
Disc scrubber	-1	1	1	-1	0
Round scrubber	0	1	-1	1	1
Pressurized water	0	0	-1	1	0
Rotative Brush	0	-1	0	1	0
Vacuum cleaner	-1	-1	-1	0	-3
Pneumatic system	-1	0	-1	-1	-3

Table 6 Matrix of evaluation.

With this matrix it was possible to select the round scrubber as the best main object of the concept.

After that, the virtual model of a concept was elaborated taking into account the dimensions of the sink in kitchens. The model is shown in figure 7.

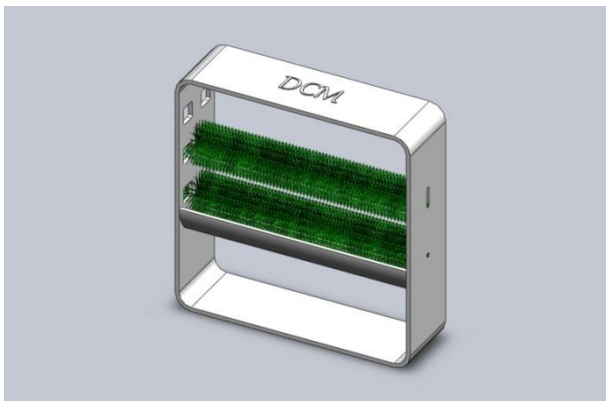


Figure 7 Virtual model

The prototype was manufactured using 3D printing technology with ABS material (figure 8) and commercial parts like round brushes, pulleys and gears. Figure 8 shows the prototype printed in 1:2 scale.



Figure 8 Prototype

Thanks to this prototype the product functionality was validated and problems of the mechanical transmission were solved

Conclusions

First of all, it was possible to obtain the main characteristics for the development of new products applied to reduce the kitchenware washing time

Also, it was found that the product that helps the most to reduce the kitchenware washing time must scrub dishes and cutlery automatically.

In parallel, it was possible to find through the motion timing study that the most used utensils and the ones that require a major cleaning time are dishes and cutlery.

In addition, a prototype to scrub dishes and cutlery was manufactured.

Finally, the results obtained in this project can be used to generate new concepts and products applied to the kitchenware washing process.

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[1] Ulrich, K., & Eppinger, S. (2009). Diseño y desarrollo de productos. Masachussets: McGraw Hill.