

RESEARCH ON THE DEVELOPMENT OF A CLOTHES IRONING DEVICE

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ABSTRACT: Having as a starting point the need to iron any type of clothing item in the best possible quality and in the shortest possible time, it is proposed to develop a product named an clothing ironing device. In order to carry out the work, the essential steps are presented: business strategy, competing concepts, development of the chosen technical solution for the purpose of obtaining and developing the product, which has a semi-automatic system with air transmission, through a fan and technology generated by air voltage warm.

Key words: iron, product, development, air, transmission.

1. Introduction

In order to choose a product that would minimize the customers time in household chores, a number of five ideas were analyzed, after which it was decided to continue the project with the clothes ironing device (Baloon Air-oning).

This paper deals with relevant aspects regarding the development of a product intended for ironing clothes through a hot air system.

The need that led to the development of this work is to iron clothes in a short time and with little human effort. The purpose of the device is to iron textile products such as skirts, trousers, blouses, shirts. Being an innovative product that fulfills its ironing function, with the help of a hot air system, but also by means of a balloon, it evens out the clothes to be ironed.

The objectives pursued in this work are: the analysis of the entire life cycle of the product, the planning and development of the possible technical solutions for the realization of the optimal concept and the realization of the technical solutions for the selected product and the prototyping of the product.

2. Business strategy

Need analysis

Marketing aims to achieve in the best conditions the satisfaction of consumers and implicitly the profitability of the company, within a dynamic company-consumer process. To make an analysis of the need, it started first of all from the long time and the high human effort.

A questionnaire was made to identify the needs of users of the ironing device, this questionnaire being made up of 18 questions, these being divided into two parts "Buyer classification", to find out which category the product was addressed to, respectively "Buyer's opinion" to provide concrete information on the ironing process, but also on its improvement, which is related to the theme proposed in the questionnaire. Therefore, an analysis of the need was carried out according to certain criteria for their identification and characterization.

The identification and characterization of the need is presented in Table 1.

Table 1. Specific needs

No.	Need	Parameter	Value
1.	Be easy to use	Mechanism	Button operation
2.	Make it durable	Material	nylon (balloon)
3.	Be efficient while ironing	Smoothing wrinkles Optimum level of reliability	80-85%
4.	To be ironed quickly	Ironing time Duration	Shirt-7-10 min Blouses- 7-10 min T-shirts- 5-7 min Pants- 10-15 minute Skirts- 7-10 minute
5.	Have a reduced size	L x l x h	Dimensions (with the top during operation): cca 60 x 20 x 100 cm Dimensions (with the bottom during operation): cca 60 x 20 x 120 cm Weight: cca 2,2 kg
6.	The clothing product that is still wet can be ironed	Temperature	4 programs: Cotton- 204 °C Polyester-148 °C, Nylon-170 °C Silk-148 °C
7.	The need to sanitize clothes and smooth out wrinkles	System with a hygienic role of eliminating bacteria from the surface of fabrics	Air jet program; Air jet pressure - minimum 5 bar, maximum 8 bar Steam jet 170g/min
8.	Adjustable in height and width	Specific balloon/rod/hanger dimensions	4 dimensions (sizes can be found in the tables below): <ul style="list-style-type: none"> • S • M • L • XL
9.	Pleasant appearance	Design	-
10.	Have an automatic shut-off system	Automatic warning/stop system	The automatic shutdown function is activated when the device detects
11.	Low noise level		60-65 decibeli

Functional analysis of the need

In order to establish the existence of the need for the device, it is necessary to know who the device serves, on whom the system acts and for what purpose this device exists.

The device serves the man who in the present case is the user to provide quality to the clothes to be ironed, being also the main function, and the goal is to reduce ironing time and human effort.

The product functions are presented in table 3.1, and environmental elements and the interfaces of these elements with the clothes ironing device are shown in figure 3.1.

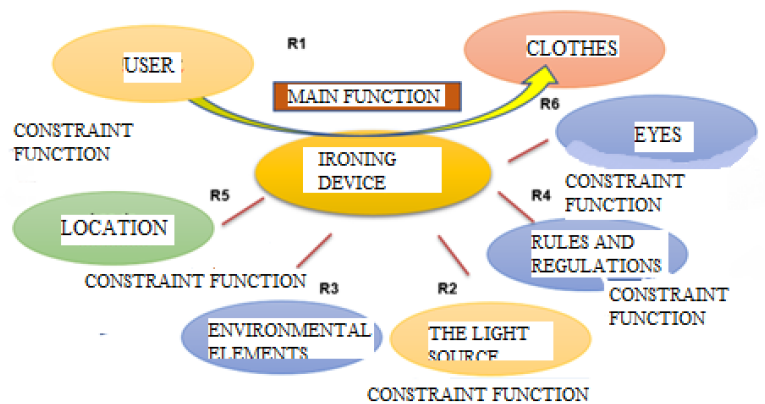


Fig. 1 Functional analysis

Table 2. Product functions

Environmental elements	Actions of the environment element (functions)
User	It helps to achieve the main function
Clothes	Allows the user to change the state of the clothes
Location	The product adapts to the location
Environmental elements (dust, humidity, temperature, vibration)	The device to withstand environmental elements
The energy source	The device connects to the power source
Rules and regulations	The device must comply with the rules and regulations in the field
Eyes	Let it be aesthetic

R1- Main function = The product allows the user to change the state of the clothes




R2- Constraint function = The product can affect the condition of the floor


R3- Constraint function = An environmental element can affect the state of the product

After the analysis, it emerges that the first function, the one that allows the user to change the condition of the clothes, is the most important. For the realization of the concepts related to this project, this function was respected with priority.

Competing Products (Competitive Analysis). In order to determine which features can be implemented in the new model of ironing device, the main features, advantages and disadvantages of these types of products on the market were analyzed. The analyzed products are presented in the following table.

Table 3. Specifications comparison

No.	Existing products	Characteristics	Benefits	Disadvantage	Applied prices
1.	The Aero360 hot air inflatable [8] 	Contains inflatable balloon Power: 1800 W Supply voltage: 220 - 240 V	Easy to use and store. Adjustable in height and width. Automated. Includes clothes drying program. Suitable for almost all sizes.	Only t-shirts/shirts can be ironed. It can only be powered from the socket. It does not have an anti-limescale system.	399 lei
2.	Tefal Pro Style IT3440E steam iron [9] 	Power: 1800 W Variable steam: 30 g/min On/Off function Steam adjustment levels: 3 The anti-limestone system	Fast and precise. User friendly. Fast heating Refreshes and sanitizes. Anti-calc solution. Provides a flat surface to keep clothes still.	It is pressed by hand. It has no clothes drying process. It can only be powered from the socket. It needs water.	365 lei
3.	The MaxxMee inflatable [10] 	Contains inflatable balloon Power: 1000 W Supply voltage: 220 - 240 V Maximum weight supported: 2.5 kg	Steam ironing function. Small dimensions and easy storage. Easy to use and store.	Only t-shirts/shirts can be ironed. It can only be powered at the socket. It does not have an anti-limescale system.	299 lei

4.	<p>TUBIE - clothes drying and ironing robot [11]</p> 	<p>Contains inflatable balloon Power- 3200 W Supply voltage: 220 - 240 V Weight- 15 kg Cable length- 3m Material: Stainless steel</p>	<p>Hot air ironing function Manual adjustment of temperature / material. Small dimensions and easy storage.</p>	<p>Heavy weight. It can only be powered at the socket. Only t-shirts/shirts can be ironed. High price.</p>	6499 lei
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In conclusion, according to the previous table, some information was obtained about the current market and the main characteristics of a product similar to the one that was developed, this helps that there are new improvements that can be brought to the market to capture an audience as larger. The main competitors for our product were analyzed in order to be able to observe the size of the market. So, in table 4. the main competitors for the ironing device are presented:

Table 4. The main competitors

No.	Producer	Headquarters	No. employee	Fiscal value
1.	TEFAL	France	>100	3 300 700
2.	Cleanmaxx	Turkey	50	2500 000
3.	TUBIE	Germany	>100	2440 800

Market segmentation. Through market segmentation, the aim was to identify groups of consumers with common needs, in order to adapt the products and their marketing in an effective way for those groups. The objective of market segmentation is to minimize risk by determining the products that have the greatest chance of gaining a share of a target market, which will help determine the best way to offer the products to the market, to buyers.

From a demographic point of view, the profile of potential customers was analyzed, resulting in a target group consisting of people aged between 18 and 50+ years.

Also, an analysis was carried out on the gender of the people, from which it emerged that most of the people who completed the questionnaire are of the female gender.

From a psychographic point of view, the results show that more than half of people iron clothes according to need, this helps to create the ironing product and improve the ironing process because we are addressing a wide target audience.

Following the analysis of some jobs performed throughout the country, close percentages emerged, but the highest percentage is within the legal-administrative field, being also imposed a certain elegant outfit that requires a special and impeccable ironing of the clothes.

Target customer profile. To create the target profile, an analysis was carried out taking into account the previously mentioned interest segment. Demographically, the user's age is 18-50 years old, predominantly female, time-stressed, and their workplace may be office, field, or a combination thereof.

3. Technical solution development and prototyping

A product concept is a rough description of the technology, the principles of operation and the form of the product [1].

Next, two conceptual options will be presented that fulfill the functions established for the product to be developed.

Concept A. The first product concept that meets the established need features 2 detachable parts, namely, 2 nylon balloons. The first balloon is specially designed to place t-shirts/shirts/blouses and the second one is suitable for trousers.

This concept requires more human effort to use as it involves the effort of swapping heads and lining up the garments. Catia V5 software was used for the 3D design of Concept A.

In table 5 shows the component elements as follows:

Table 5. The functions of the component elements

No.	Component elements	The functions of the elements
1	Motor	It converts electrical energy into mechanical energy
2	Timer	It measures the ironing time
3	Telescopic rod	Support function
4	Support legs	Support+support function
5	Fan	It generates an air flow
6	The ventilation holes	Ventilation function (casing ventilation)
7	Mounting flange	Mount/Assembly function
8	Clips with elastic cord	Grip function
9	Collar section	Support function
10	Blouse-type nylon balloon	Ironing function (role in placing clothes)
11	Nylon trouser balloon	Ironing function (role in placing clothes)
12	Microcontroller	Information storage function
13	LED screen	Display information
14	Thermostat	Temperature measurement function
15	Electrical resistance	Heating function
16	Power cable plug	Power supply function
17	Control panel	Program management function/light indication
18	220V to 5V transformer	Electric current conversion function
19	Relay	
20	"PUSH" type button	Electric circuit activation function
21	Temperature and pressure sensor DTH	Temperature and pressure measurement function

Concept B

The second concept is the mannequin type, where two clothing items such as a blouse and trousers can be ironed simultaneously. Its efficiency is much higher by the fact that time is saved and human effort is reduced. In order to design the 3D concept B, the Catia V5 software was used in Fig. 3.

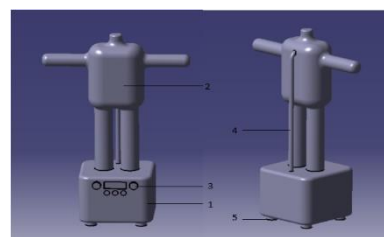
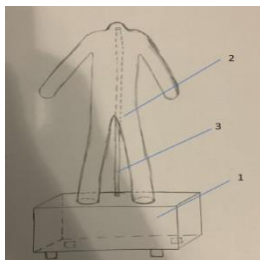


Fig. 2. Concept sketch B where 1. Housing, 2. Dummy balloon, 3. Telescopic rod

Fig. 3. Design Concept B where 1. Housing, 2. Dummy balloon, 3. Control panel, 4. Telescopic rod, 5. Support legs

The version of the technical solution has been finalized, which includes the following components, divided into the mechanical subsystem, the electrical and electronic subsystem and software.

Following the analysis of the hierarchization of the criteria of the two concepts (production costs, dimensions, ease of use of the product), the analysis of the concepts and their comparison, concept A was chosen for further development, taking into account the expressed needs of consumers the most. The product requires minimal storage and installation space, the emphasis is on ironing clothes according to the need, either pants or blouses, it does not require much assembly time.

Unlike the classic iron, the clothes iron (innovative) ensures a large amount of hot air that penetrates deep into the fabric, so that the clothes will become perfectly smooth without much effort. The warm air circulates through the clothes, gently drying them, leaving a pleasant smell and soft fabrics to the touch. It

is equipped with an air ironing function for sanitizing clothes and smoothing wrinkles, with an intuitive control panel with the help of which a timer has been set.

In addition to the impeccable effect brought to the clothes, the large amount of air also has the hygienic role of removing bacteria from the surface of the fabrics. The warm air will inflate the balloon and penetrate the fabric drying the material, while the tension generated by the balloon will smooth out all the creases. The nylon balloon ensures perfect and even drying of t-shirts, blouses or shirts in sizes between S-XXL.

Product functionality



Fig. 5. Concept A



Fig. 6. Ensemble Concept A

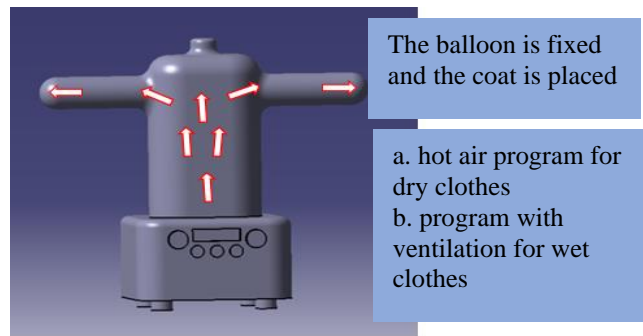


Fig. 7. Product Operation

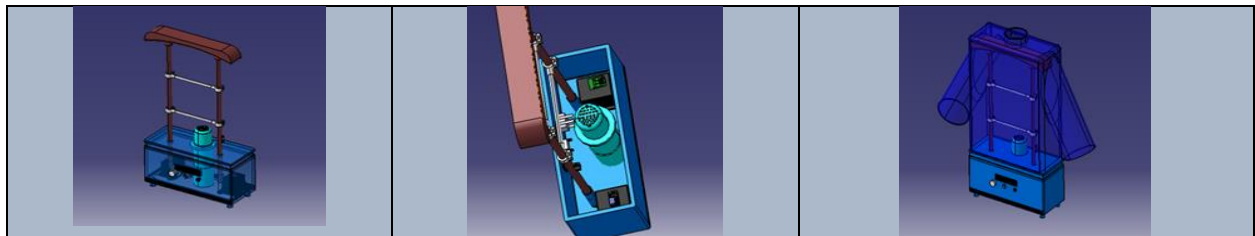


Fig. 8. Final assembly

Experimentation and prototyping

To create the prototype, some experiments of possible functionalities were first carried out.

The first experiment concerns the connection of a temperature and humidity sensor to a micro-controller, with the aim of finding out the temperature and humidity inside the inflatable balloon during the use of the product.

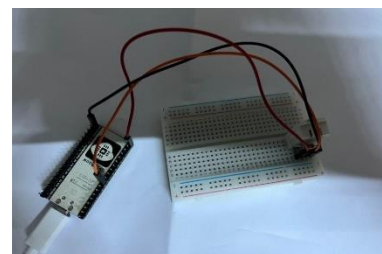


Fig. 9. Testing- temperature and humidity

As a result of the experimentation, the measurement of temperature and humidity was successful, as well as the integration of a WEB server on the ESP32 development board that allows WIFI access to a Web interface that displays the temperature and humidity measured in real time.

The second experiment was carried out by connecting a servomotor to the micro-controller. The experiment was carried out in order to be able to remotely control the actuation of the servo motor by turning it in one direction or another.

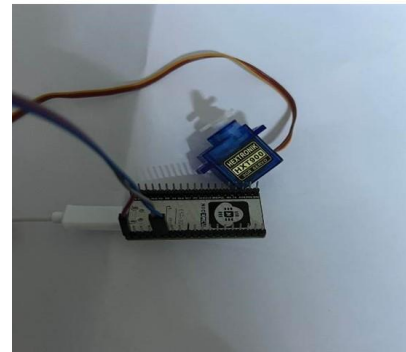


Fig. 10. Electric motor propeller rotation testing

It was possible to operate the rotation of the electric motor propeller in a range of 0-180° to the right or 0-180° to the left.

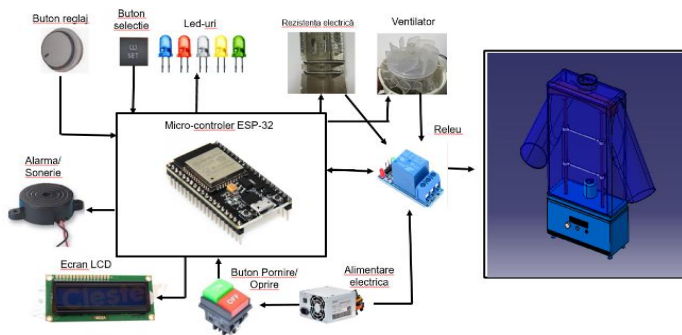


Fig. 11 Electrical system architecture

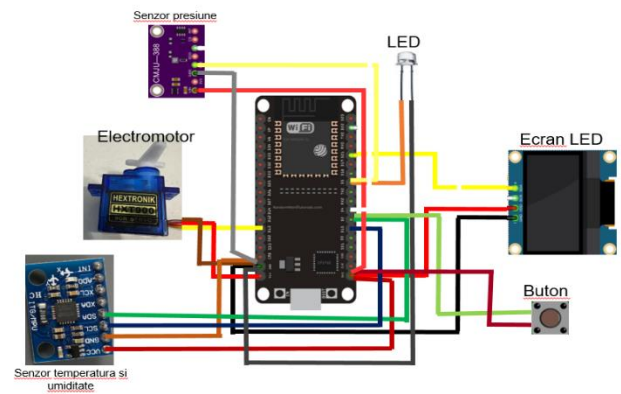


Fig. 12 Diagram with the connection diagram

In order to create the prototype, in the second semester of the academic year 2022-2023, tests and experiments of some subsystems of the product were carried out. In addition to the already existing component elements of an existing device, automated control functionality has been developed through a relay that can command various working modes with different firing times programmed according to the algorithm running on the ESP 32 microcontroller.



Fig. 13 Elements components

The tests confirmed the possibility of programming by means of the ESP32 microcontroller several working modes corresponding to certain ironing cycles. The correct dimensions of the electrical and electronic components were also confirmed. The potential for the development of intelligent functionalities that could assist the users of such ironing systems was demonstrated.

4. Economic analysis

In order to perform the economic analysis of the product, the cost of the product was realized. The total unit cost of the product is 223 lei/piece. The selling price of the product is 306 lei, with a profit margin of 40%. In order to reach the profitability threshold of our product, it is necessary to sell in one year 1652 pcs.

5. Conclusions and perspectives

The project used numerous analysis methods to objectively choose the functions that the product must have in order to satisfy the needs of the customers. The start of the project was based on a modern method of generating ideas, namely, the brainstorming method.

A number of five ideas were analyzed, after which it was decided to continue the project with only one.

In order to be able to form an overview of the product typology based on an idea like the one we selected, we chose to use the questionnaire method. This method provided enough information to be able to move on to the next step, namely, to research the market, to perform functional analyses, both internal and external, but also to create the profi

In addition, market segmentation was carried out in order to choose the target customer.

To create the product, two concepts were designed with the help of the Catia V5 software.

In order to create the prototype of the technical solution, research was carried out to find the components necessary to satisfy the functions and needs, their compatibility and their realization.

In the next period, the main objective is to finalize the technical solution, to make the product prototype, to test and analyze the results, so as to improve the stage at which it is for placing the product in production, to define the schedules ironing.

To demonstrate the potential of developing intelligent functionalities that could assist the users of such ironing systems.

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