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Design of an Automated Adaptive Rocking Mechanism for Baby Strollers

This work presents an updated rocking system designed as an external accessory that can be attached to most baby strollers, enabling a smooth and repetitive motion without the need for manual pushing. The device is based on a compact mechanical-electrical assembly that transfers movement through a pair of drive wheels powered by a low-voltage motor. Its design aims to offer a simple and lightweight solution that can be easily installed and removed, allowing caregivers to generate a gentle rocking motion in a controlled and autonomous manner. The technical characteristics of the mechanism, its components, and its operating sequence a redescribed, together with the criteria followed during the design process. The proposed system provides an adaptable structure capable of working with different stroller geometries and offers a practical alternative to existing rocking devices. The study focuses on demonstrating the technical feasibility of the prototype and establishing the basis for future improvements and experimental testing.

***Keywords:** babies; devices; trolley; calm; oscillating movement.*

1. INTRODUCTION

The baby equipment sector has evolved rapidly in recent years from the point of view of technical development for commercial purposes [1,2]. Many of these advances are the result of the use of new materials, new tech–nologies, and market demand.

In addition, user-centered design proposals applied to the pediatric environment are increasingly being pro–posed [3]. Society has evolved towards consumerism, and as in otherin dustrial sectors, commercial brands of baby strollers seek to be pioneers in the commerci–alization of new products: strollers with better direc–tionality, with more positions to place the baby, more foldable to better adapt to the trunk, strollers for hiking, strollers to be able to go out running with thebaby, etc. [4,5]. In fact, the design of tools and met–hodologies for identifying the aspects most in demand by stroller users, such as technologies for simulating certain situations through virtual reality [6], are a fruitful line of research at present[7]. There are also studies that analyze ergo–nomic aspects related to the active use of the stroller, such as running while pushing it, which implies a bio–mechanical adaptation of the design [8]. Consequently, every year the different brands offer a new model that, by presenting better features, makes the previous one obsolete.

One of the most important features in baby strollers is safety [1,4], and for this reason different mechanisms have been studied. This in cludes research on the effects of vibrations transmitted through the wheels on different surfaces and their potentia limpact on the baby's well-being [9], for example, to improve safety inside a bus [10], or to improve the stability of the baby [11] inside the carry cot when handling the stroller on slopes. On the other hand, the aspect of comfort is another of the most noteworthy features in the baby equipment com–mercialization sector. In this sense, there are many complements that can make the baby carriage more comfortable [12]: protection from the sun, rain, or the incorporation of toys to entertain the baby. Likewise, the specialized literature reveals that the extension of the useful life of the stroller and its durability is one of the most important incentives that motivate the decision of potential buyers to purchase the product [13].

In recent years, there has been a tremendous amount of research in the technological development of baby devices [14,15]. In this regard, the main aspects that are demanded by these baby devices are the following (Fi–gure1): (i) safety for the baby [1,15,16]; (ii) economy [15]; (iii) ergonomics [14,18]; (iv) weight; (v) durability [13,20]; (vi) resistance [20,21]; (vii) comfort for the baby [22,23]; and (viii) user experience [24,25]. More–over, the increasing environmental awareness of socie–ties causes consumers to demand sustainable products, also in the stroller market [26,27].

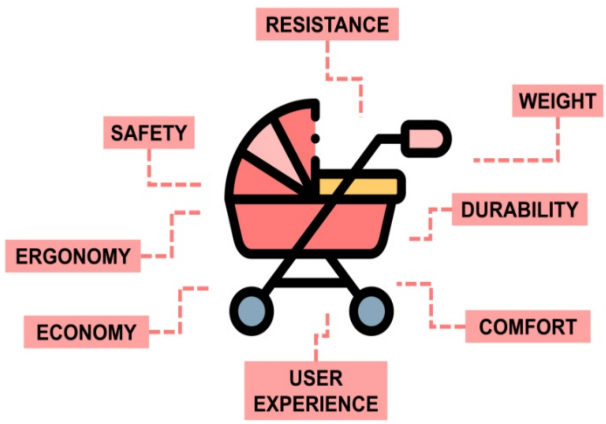

Figure 1 .Main aspects demanded from baby devices.

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Despite the speed with which new technological developments are appearing around baby strollers, new advances in this sector are emerging every day, given the great demand that exists in the market. Within this line of work there are also recent designs of baby strollers, called intelligent, which are self-propelled to make it easier for parents to handle the stroller [28,29].

There are multiple references in the state of the art to rocking devices for baby cribs and strollers [3,30], as it has been proven that infants tend to fall asleep inside the stroller [23,31], particularly when the stroller is in motion, and preferably when it has some rocking motion. Some of these devices are gadgets that are deposited on the floor, which through a connecting rod or a similar mechanism transmit a back-and-forth motion to the baby's stroller or crib.

Another more advanced solution is represented by a series of mechanisms formed by a set that is coupled and uncoupled with respect to the stroller frame [32], which include a mechanism of double direction of rotation, driven through a transmission by means of a motor whose rotation movements in both directions are commanded by a controller associated with an electric battery power supply of the motor itself, whose movement translates into a displacement of one of the wheels of the stroller [33].

The main limitation of these approaches is that the movement is generally transmitted to only one wheel of the stroller, so that the overall displacement is not completely controlled. If the non-driven wheel is braked or blocked, the resulting motion incorporates an undesired lateral rotation; if it moves freely, the stroller may behave unpredictably depending on floor conditions—for example, a slippery surface would allow the free wheel to travel further than the driven one, while a carpeted surface may restrict the movement of the driven wheel itself. In addition, many of these solutions are not conceived as universal accessories, since they depend on a particular stroller geometry or require integration into the original stroller structure, which limits their portability, interchangeability, and practical applicability across different stroller models.

On the other hand, a Baby Balanz® is another device [34] based on a concept similar to that of the system presented here, namely BABY-CALM. However, the device differs substantially from the one presented in this paper, particularly in terms of portability. Unlike BABY-CALM, which can be easily transported due to its reduced dimensions and weight and can be placed under the baby's stroller, Baby Balanz® is not designed for comfortable use outside the home environment.

Unlike many existing stroller rocking systems that operate only on one wheel, the BABY-CALM device transmits the movement simultaneously to both rear wheels of the stroller through a synchronized shaft system. This solution improves the stability and control of the rocking motion while reducing undesired lateral displacements. In addition, the proposed mechanism is fully independent from the stroller structure, detachable, portable, and adaptable to different stroller geometries without requiring modifications to the stroller itself. These characteristics represent important engineering advantages compared to existing integrated or single-model solutions currently available on the market.

From an engineering perspective, the originality of the BABY-CALM device lies not only in the development of an autonomous rocking mechanism, but also in the combination of several functional characteristics within a single adaptable system. These include the synchronized transmission of motion to both rear wheels, the detachable and portable structure, the compatibility with different stroller geometries, and the use of a compact low-voltage electromechanical configuration capable of generating controlled cyclic motion. Unlike many existing systems, which are integrated into specific stroller models or rely on single-wheel actuation, the proposed mechanism was conceived as an independent universal accessory intended to improve operational stability and practical usability.

There are also smart strollers on the market, such as Smartbe®. These models incorporate electric motors that provide assistance on slopes and also enable rocking motion. However, they present several important limitations, such as a high price and a non-universal, non-interchangeable design. In view of the rocking systems market for baby strollers, the prototype presented here, called BABY-CALM, may be attractive to any brand of manufacturer, since it embodies the design of a universal mechanism that aims to be adaptable to any size and dimensions. The authors registered this prototype as a utility model with the Spanish Patent and Trademark Office under code ESU201831434. This device is independent of the stroller itself and adaptable to any model and type of baby stroller, so that its acquisition can be made even if you do not know the model it is intended for, while it can be installed or uninstalled from the stroller quickly and easily.

In this context, rocking is understood as the gentle and silent oscillating movement applied to the stroller with the aim of soothing the baby or helping them fall asleep. This motion consists of small forward and backward displacements, imitating the manual movement typically used for the same purpose.

The practical application of the BABY-CALM device is mainly related to its use as an autonomous accessory capable of generating a controlled rocking motion in baby strollers without requiring manual intervention by parents or caregivers. This functionality may be useful in domestic environments, childcare facilities, waiting areas, hospitals, or other contexts in which a gentle and repetitive movement can help soothe the baby while reducing the physical effort required from the caregiver. From an industrial perspective, the device may also be of interest to stroller manufacturers because it is conceived as an independent and adaptable mechanism that can be installed without modifying the original stroller structure.

2. MATERIALS AND METHODS

The objective of the present mechanism lies in satisfying a concern that many parents live daily with their babies: the problem of putting them to sleep. The mechanism proposed in this paper, being adaptable to any baby stroller, would help the baby to fall asleep by the cyclic rocking movement, freeing the parents from having to do it manually and allowing them to do other things. The BABY-CALM device, by making a slow, short-distance (0.5 meters), cyclic motion, would be totally safe for the baby.

With this in mind, as shown in the project planning (Figure 2), different phases have been developed for the design of the different elements of the device, as well as the electrical and electronic components:

(i) Phase I – preparation and design –: component pre–paration and design creation;

(ii) Phase II-a – electrical assembly –: assembly of elec–trical and electronic elements;

(iii) Phase II-b – mechanical assembly –: creation of a 3D prototype;

(iv) Phase III – final prototype –: modification of the initial design based on the experience gained to obtain the final version of the BABY-CALM device.

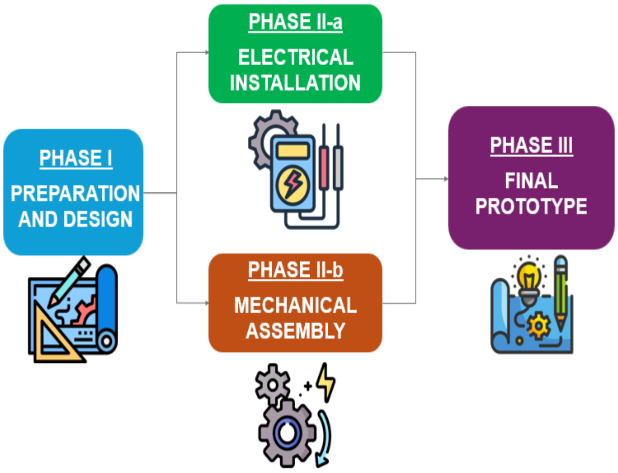


Figure 2. Project planning: mainphases.

The development of the project has been structured into four well-defined phases. This phased development approach is consistent with mechatronic product design methodologies, in which the mechanical structure, elec–tronic components, control functions, and system integ–ration are considered jointly during the design process [35].

In Phase I (Preparation and Design), electrical sche–matics, sketches, and 3D models were created using SolidWorks software. This allowed the detection of possible anomalies before proceeding with the machi–ning process, and an estimation of the resources needed to carry out the project was also made.

In Phase II-a, the necessary electrical components for the operation of the device were assembled. Next, in Phase II-b, the mechanical parts of the prototype were machined and assembled. Finally, in Phase III, the elec–trical and mechanical systems were integrated, allowing the prototype to operate correctly under real conditions.

The initial design was assembled on a small vehicle created with different materials: methacrylate, nylon, aluminum, and stainless steel. This vehicle is intended to simulate a baby carriage on a small scale, so that the effectiveness of the BABY-CALM rocking device can be tested. In this way, thanks to this model, it will be possible to know and understand the functioning of the BABY-CALM mechanism and all the possible impro–vements to be applied.

Regarding Phase II-a of the electrical design and assembly (Figure 2), three electrical/electronic devices (Table 1) have been installed on the vehicle to perform several functions.

From a kinematic standpoint, the angular speed of the DC motor is obtained from the nominal speed as:

$$\omega = \frac{2\pi n}{60} \tag{1}$$

where n is the motor speed in rpm and ω is the angular speedin rad/s. The linear velocity transmitted to the stroller wheels is then given by:

$$v = \omega r \tag{2}$$

where r = 0.0295 m is the drive wheel radius. The rocking motion consists of the periodic repetition of a forward stroke and a backward stroke, each of length L = 0.5m. The time required to complete one stroke is:

$$t = \frac{L}{v} \tag{3}$$

and the full cycle period is:

$$T = 2t = \frac{2L}{v} \tag{4}$$

The corresponding rocking frequency is:

$$f = \frac{1}{T} \tag{5}$$

For the nominal motor speed n = 5.2 rpm, ω = 0.544 rad/s and $v \approx 0.016$ m/s. Each stroke takes approximately $t \approx 31$ s, resulting in a cycle period $T \approx 62$ s and a rocking frequency $f \approx 0.016$ Hz. This low-speed condition is con–sistent with the objective of generating a slow, smooth, and controlled cyclic motion for infant comfort and safety.

Table 1. BABY-CALM electrical/electronic devices.

Identification Number	Definition	Description
1	Power/force circuit	. Engine specification (Figure 4a): Rated Voltage: DC12 V No-Load Speed: 5.2+10% RPM Rated Torque: 6.86N·m (28 kg children) Rated Torque max.: 15N·m Rated Current: 1 A . Battery specification (Figure 4a): 12 V dc and 3500 mAh
2	Circuits for motor starting and reversing	Motor starting and reversing, as well as for motor speed control (Figure 3b).
3	Start-up and reversing circuit	Circuit using micro-switches (Figure 3c).

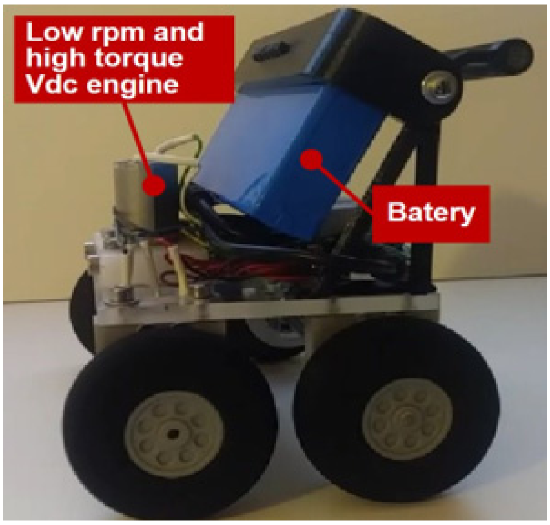
In the power and force circuit (Figure 3a) are the power contacts associated with the drive relays (Figure 4a) of the motor (KDM1 and KIM1) (Figure 4b), the speed regulator for the motor (RVdc), and the motor itself (M1) (Figure 4c).

In the start circuit (Figure 3b), the right-hand rota–tion of the motor is activated by pressing the start button (S2) (Figure 4a).

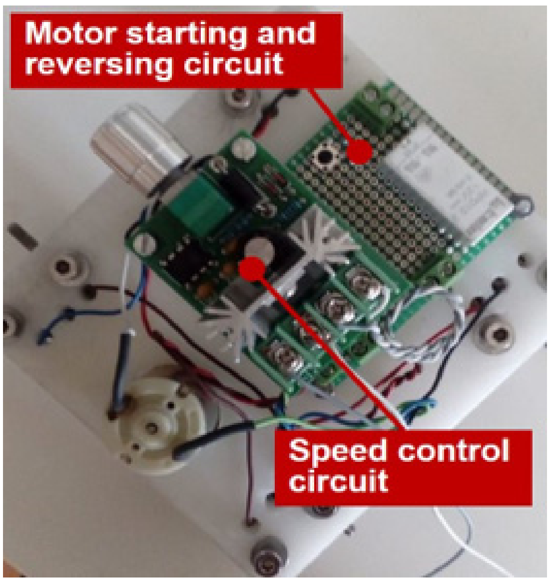
In the motor start-up and reversal circuit (Figure 3c), each set of two microswitches is used for each direction of rotation (Figure 4b). Once the system is started, the position microswitches (S3 and S4) (Figure 4b) are associated with the system, switching the reversing signal for the drive motor (KDM1 and KIM1) (Figure 4c). The system stop button (S1) is also located in this circuit.

In the motor start-up and reversing circuit (Figure 3c), the position microswitches (S3 and S4) (Figure 4b) are operated by means of mechanical cams designed by the authors and made with nylon, which have been installed on the drive shaft (Figure 5).

Finally, to the start-up and reversal circuit using mic–roswitches (Figure 3c), another electronic circuit has been coupled to regulate the speed of the 12-volt DC motor using an LM317 integrated circuit (Figure 4c). This com–ponent, through a variable resistor (potentio–meter), regulates the motor rotation speed, since this type of DC motor has a high number of revolutions per minute.



(a)



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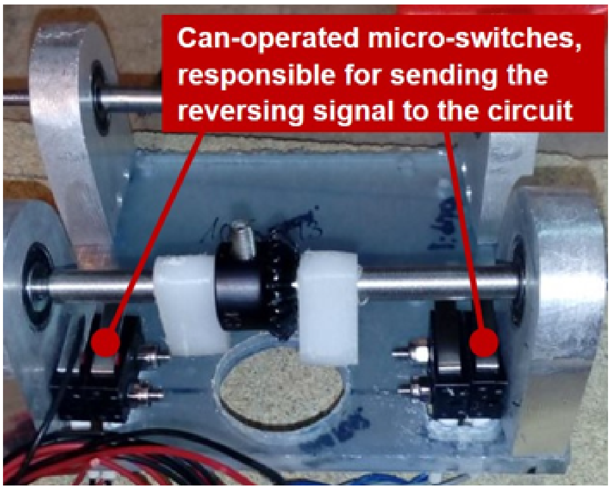


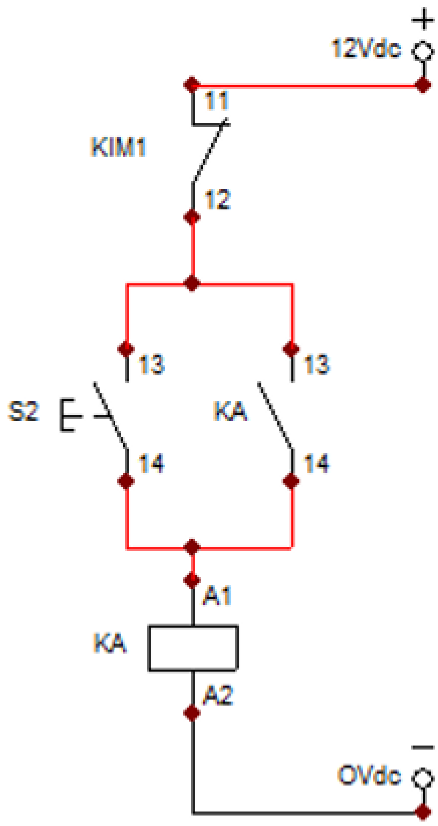
(c)

Figure3. Electrical circuits of the system: (a) power and force circuit; (b) motor starting and reversing circuits as well as motor speed regulation; (c) start-up and reversing-circuit using micro-switches.

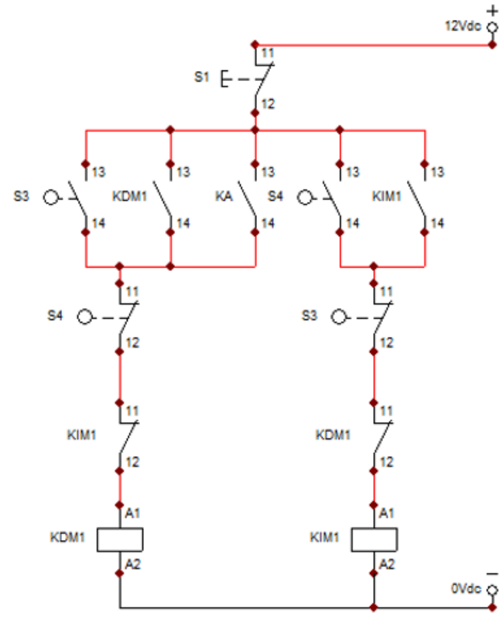
This system (Figure 4c) is important for the motor to rotate at a low speed and to ensure the integrity of the users, who, being babies, need a high level of safety. Finally, the transmission of motion from the motor to the drive shaft has been realized with a set of bevel gears in a cut-shaft configuration (Figure 5).

The definition of the drive mechanism and its transmission elements is a relevant aspect in the design of functional mechanical systems, since the geometry and actuation conditions directly affect the resulting motion and operational performance [36].

One of the gears is installed on one of the shafts and the other on the motor shaft.



(a)



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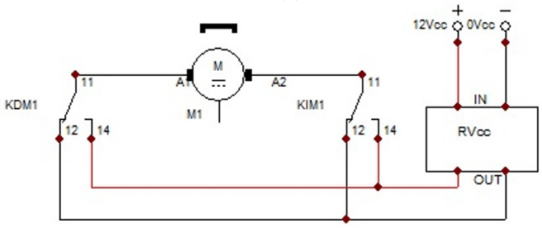
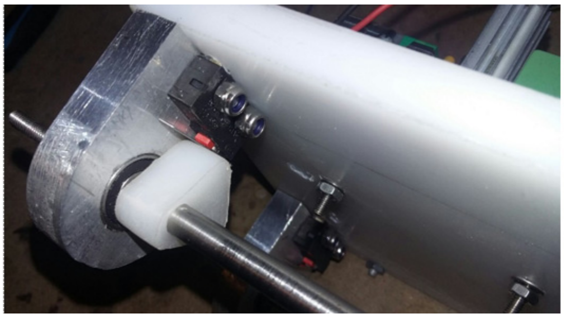
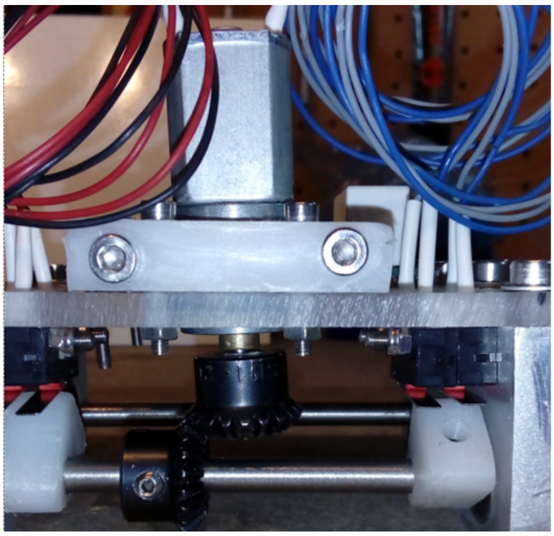


(c)

Figure 4. BABY-CALM control circuit: (a) General starting-circuit; (b) Control/operating circuit; (c) Power/force circuit.



(a)



(b)

Figure 5. Views of the cams on the driveshaftwith the micro -switches.

3. PROTOTYPE DESCRIPTION

In the final version (Phase III, Figure 2), the baby stroller rocking device consists of an assembly that can be coupled and uncoupled with respect to the frame of a baby stroller. This device includes a mechanism of double direction of rotation, driven through a transmission by a drive motor whose rotation movements in both directions are driven by an electric-electronic controller associated with an electric power supply battery, whose movement is translated into a displacement of the stroller.

The BABY-CALM device is developed on a hollow bar that has at its ends small wheels that are in direct contact with the wheels of the baby stroller. A shaft transmitting movement by means of a direct current motor is housed inside this bar. Finally, the motor-shaft coupling is made with a set of bevel gears. The stroller rocking device is characterized by the components indicated in Table 2 and reflected in Figure 6.

As can be seen, the BABY-CALM device consists of a central housing (1) which integrates the drive and control mechanism of a shaft (3) protruding from it in opposite directions. Bearings (2) serve as a link between the central housing (1) and the axle (3), allowing the axle to rotate without friction. This housing includes a mechanism with a double direction of rotation, driven through a transmission by means of a drive motor whose rotation movements in both directions are controlled by a controller associated with an electric battery supplying the motor itself.

Table 2. BABY-CALM components.

Identification Number	Definition	Description
1	Central casing	It integrates the motor and supports the bearings located at the ends of the mechanism.
2	Bearing	At both ends of the shaft, respon–sible for transmitting the loads from the shaft to the housing.
3	Shaft	The shaft runs through the entire mechanism and transmits the motion between the two ends, ensuring that the wheel srotate.
4	Wheel	The wheel supports the tire and transmits the forces between the tire and the axle.
5	Bolt	Fastening bolt between rim and axle.
6	Tire	Improves the adhesion of the mec–hanism to the rear wheels of the trolley.
7	Subjection	Attachment of the mechanism to the trolley assembly.
8	Carriage	Baby carriage set.

This mechanism has means of programming sequ–ences of movements optionally controlled through a computer application that interacts with the equipment's controller, allowing multiple advanced options, such as emitting music or audible sounds for the baby, or matching its movements to the music or sound.

As can be observed in Figure 6a, at the end, the shaft (3) is fitted with wheels (4) that transmit the movement to the two rear wheels of the stroller (9). These wheels

(4) incorporate a finish with a high friction index, which we call rim (6), that can be seen in Figure 6b, that manages to drag the wheels of the stroller in its movement even when the latter is located on rough terrain or where a certain torque is required to achieve the movement of the same.

This device also has means of fastening bolts (5) that fix the wheel (4) to the axle (3), visible in Figure 6c. On the other hand, the whole assembly has means of fastening (7) to the trolley frame (8) in an area close to the wheels on which this mechanism is applied. Preferably, these means of attachment (7) to the trolley frame are clamps or other means that allow them to be adjusted to fit the diameter of the trolley frame (8).

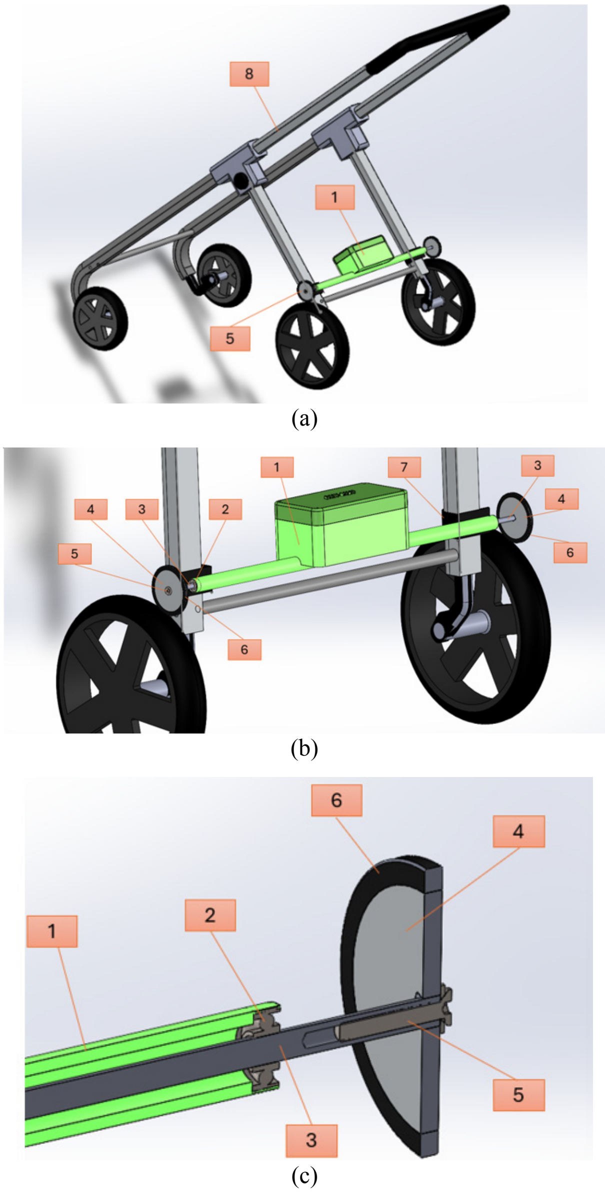


Figure 6. BABY-CALM device: (a) installation on the frame of a baby stroller; (b) breakdown of different parts of the device; c) detail of the shaft, wheel and screw assembly. (1) Centralc asing, (2) Bearing, (3) Shaft, (4) Wheel, (5) Bolt, (6) Tire, (7) Subjection, (8) Carriage

4. STRUCTURAL ANALYSIS

Static analysis using SolidWorks Simulation is a fundamental tool in the design and validation of mechanical components. This study allows the behavior of parts and assemblies to be evaluated under static loads, providing crucial information on their structural integrity and performance.

In this analysis, three key parameters are examined: (i) von Mises stresses: This criterion, based on distortion energy theory, is essential for predicting yielding in ductile materials. It allows the identification of critical zones where stresses approach or exceed the elastic limit of the material; (ii) Resultant Displacements (URES): quantify the total movement of each point of the model under load, crucial for evaluating deformations and ensuring that components maintain their functional geometry; and (iii) Equivalent Unit Strains (ESTRN): represent the relative deformation of the material, providing a detailed view of how the structure deforms at the local level.

To carry out this static analysis, it is first necessary to define the materials used to build the BABY-CALM device (Table 3). The appropriate selection of materials is key to ensuring the proper functioning, durability, and safety of the device. Below is a brief description of the materials selected for each main component of the assembly.

Table 3. BABY-CALM materials components.

Identification Number	Definition	Material-properties
1	Central casing	ABS (Acrylonitrile Butadiene Styrene) Stiffness, impact resistance, and low weight Elastic modulus: $2x10^9$ N/m^2 Poisson's ratio:0.394 N/D Elastic limit: $2.5x10^7$ N/m^2 Density: 1020 kg/m^3
2	Bearing	AISIA2 High hardness and wear resistance Elastic modulus: $2.03x10^{11}$ N/m^2 Poisson's ratio: 0.285 N/D Elasticlimit: $1.6x10^9$ N/m^2 Density: 7860kg/m^3
3	Shaft	Stainless Steel 304 Good mechanical strength and corrosion resistance Elastic modulus: $1.9x10^{11}$ N/m^2 Poisson's ratio: 0.29 N/D Elastic limit: $2.x10^8$ N/m^2 Density: 8000 kg/m^3
4	Wheel	Pphomo polymer Impact resistant Elastic modulus: $1.79x10^9$ N/m^2 Poisson's ratio: 0.42 N/D Elastic limit: $2.5x10^8$ N/m^2 Density: 933 kg/m^3
5	Bolt	Stainless Steel AISI 304 Structural strength and protection against oxidation Elastic modulus:1 $.9x10^{11}$ N/m^2 Poisson's ratio: 0.29 N/D Elastic limit: $2.06x10^8$ N/m^2 Density: 8000 kg/m^3
6	Wheel cover	Material: Polyurethane (11671) Good balance between elasticity and stiffness Elastic modulus: 6.0×10□ N/m^2 Poisson's ratio: 0.49 Elastic limit: 4.5×10□ N/m^2 Density: 1225 kg/m^3

The von Mises stress, used to assess yielding in ductile materials, is defined as:

$$\sigma_{vM} = \sqrt{\frac{(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2}{2}} \qquad (6)$$

The safety factor against yielding for each compo–nent is:

$$C_S = \frac{\sigma_y}{\sigma_{vM}} \qquad (7)$$

The von Mises criterion is a crucial indicator for assessing the stress state in ductile materials. By analyzing the stress results obtained in SolidWorks (Figure 7a) according to the von Mises criterion, it can be observed that the values do not exceed stresses of more than 2 N/mm², which indicates areas with very low stress and virtually no significant loading.

When comparing these results with the elastic limits of the materials used (Table 3), the maximum values do not exceed this limit and there is therefore no risk of permanent plastic deformation.

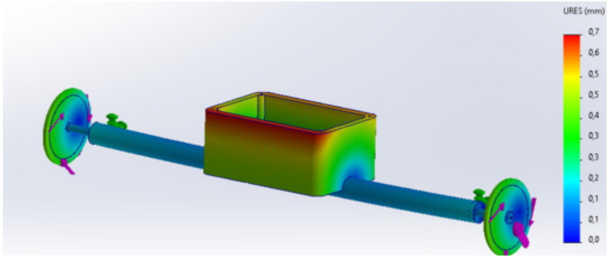
Applying (7) to the simulation results (σ_vM < 2 N/mm²) and the elastic limits in Table 3, the minimum safety factor is CS = 12.5 for the ABS casing, with all remaining components showing CS > 22, confirming that no component reaches its elastic limit under normal operating conditions.

If the results are displayed in resultant displacements (URES) (Figure 7b), the interpretation focuses on analyzing the total displacement of the nodes or elements of the model. This parameter reflects how each point of the solid moves under the applied loads and is crucial for assessing whether the displacements meet functional or structural requirements. In areas where very small URES values occur, mainly along the rim, the component is expected to be highly stiff, while large values could indicate critical areas at risk of failure due to excessive bending or displacement.

As for the equivalent unit strains (ESTRN) (Figure 7c), they are found to be very low, below 0.001, which suggests imperceptible elastic deformations typical of rigid materials subjected to moderate loads. Considering the elastic limit of the materials (Table 3), it is possible to confirm that the values of the ESTRN are not higher than these values by 0.2% and therefore do not represent the onset of plasticity of the materials.

Static analysis shows very low stress, displacement, and strain values in the critical areas of the assembly, confirming adequate structural behavior under normal static load conditions. Since the stress generated during operation remains well below the material limits, dyna–mic analysis was not considered necessary at this stage.

(a)



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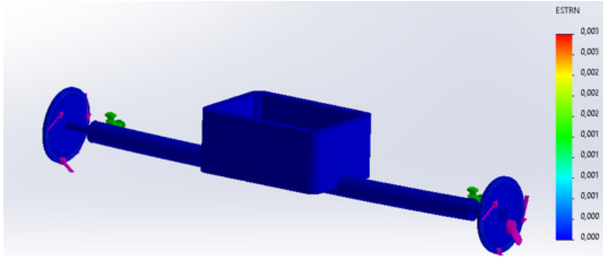

(c)

Figure 7. Views plot obtained from a preliminarily carried out static study of the BABYCALM 3D model: (a) resultant stress; (b) displacement diagram (URES); (c) views of the unit strain diagram (ESTRN).

In a preferred execution, several means are provided for adapting the BABY-CALM device to any model of stroller (8). For this purpose, the shafts (3) are telescopically installed on cylinder (1), allowing the spacing between the drive wheels (4) to be adjusted so that they always coincide with the rear wheels of the trolley, regardless of the distance between them. Like–wise, it is foreseen that the fixing means (7) to the strol–ler frame are installed on the cylinder (1) through means that allow their displacement along the same, to be able to regulate the distance that separates these fixing means and thus adapt to any model of stroller frame.

The uncoupling system consists of a hinge and spring mechanism. This system is found in the means of attachment of the BABY-CALM to the stroller (8), which allow the BABY-CALM to be pushed against the rear wheels of the stroller and causes the transmission to en–gage. The spring and clamp system ensures full contact of the BABY-CALM with the stroller wheels. If the spring system together with the clamping means (7) is not pro–perly adjusted, there will be little or no contact bet–ween the wheels, causing slippage in the mechanical transmis–sion and, therefore, the rocking motion will not occur.

In an advanced execution, the microcontroller that governs the movement of the stroller is programmable or incorporates storage or communication means to receive operating routines, which can be programmed even by the user or sequentially follow any sound or music, which optionally can be played in unison with the movement of the device, or by a stereo coupled to it. This improvement can be incorporated into the system through a microcontroller with Bluetooth antenna lin–king this through an application on the Smartphone, thus allowing the user to configure the different melo–dies, timer for the cycle of back and forth, and regu–lating the speed of the engine.

The equipment incorporates several interfaces for reprogramming or other purposes, as well as a power supply for recharging the internal battery from the common electrical network. Having described the nature of the device, as well as an example of a preferred execution, it is evident that the mechanism is susceptible to industrial application in the indicated sector.

It is also stated that the materials, shape, size, and arrangement of the elements described may be modified, provided such modifications do not alter the essential characteristics of the device. Given the broad range of potential material options, this study focuses on validating the model from a technical engineering perspective. Economic considerations—such as cost optimization aimed at enhancing the commercial viability of the final product—are beyond the scope of this work. Therefore, the results presented in this study substantiate the technical feasibility of BABY-CALM as an innovative adaptable rocking device concept for baby strollers, without encompassing potential optimization analyses intended to ensure the economic viability for the commercial exploitation of the product.

In the article's introduction, a family of features that the market demands for baby devices (Figure 1) is discussed: safety, ergonomics, weight, durability, resistance, baby comfort, and user experience. It should be clarified that the mechanism presented in this article is not intended to improve the stroller's quality in all of these aspects. Thus, for the sake of clarity, the following Table 4 explains which characteristics are invariable, because they are entirely dependent on parts of the stroller not related to our device, and which ones could be improved with the use of BABY-CALM.

Table 4. Aspects demanded baby devices and BABY-CALM dependent.

Main aspects demanded baby devices	Dependent	Observations
Safety	Direct with Stroller	These aspects depend on several technical factors related to the choice of the stroller. These technical factors can be classified into: (i) internal: chassis design, type of stroller (twin, modular or stroller), type of suspension, number of wheels, dimensions, materials, folding parts, directionality, accessories (baskets, trays, hoods), etc.; and (ii) external: age and weight of the baby. Future developments of BABY-CALM are needed to prove them in different stroller models.
Weight		
Durability		
Resistance		
User experience		
Economy	Direct with BABY-CALM	The materials and software used are commonly available, suggesting that the development and production of BABY-CALM would involve low costs, although economic evaluation is not the objective of this study.
Baby comfort		This is the objective that justifies the entire design, since it is a device designed to facilitate the child's sleep.
Ergonomics		In the conclusions section of the article, it is explained that BABY-CALM has a simple design, equipped with an easy-to-use assembly and disassembly system, and it is a universal device, which can be used in any stroller.

5. CONCLUSIONS

This device performs a slow, short-distance cyclic movement of 0.5 m, which helps the baby fall asleep through rocking while freeing parents or caregivers from performing this movement manually. The device can remain in operation for 14 to 18 hours, depending on the weight of the stroller. This device is independent of the stroller itself and adaptable to any model and type of baby stroller, so that its acquisition can be made even if the model of the stroller for which it is intended is unknown, while it can be placed or uninstalled from the stroller quickly and easily.

The scientific merit of this work lies in the engineering definition and preliminary validation of an adaptable mechatronic system for stroller rocking applications. The contribution to engineering practice is based on the integration of a compact mechanical transmission, a reversible low-voltage motor drive, an adjustable fastening system, and a structural feasibility analysis into a single functional prototype. Therefore, the proposed device provides a practical engineering solution that combines mechanical design, motion control, portability, and adaptability to different stroller geometries.

Although there are other utility models and patents for devices that develop an idea similar to that of BABY-CALM – i.e., automatically rocking a baby's stroller to make it fall asleep easily – the device presented in the present article incorporates a series of advantages over previous developments in the sector, among which the following stand out: (i) this rocking device, unlike other models, is not included in the baby stroller, but is completely independent and can be coupled to any brand of stroller; (ii) as an independent product, it is easy to use and adaptable to any model of baby stroller, in addition to being safe for the baby, since the speed and design of the movement is adapted to the needs of the child.

Currently, the authors are seeking public or private funding to be able, in a first step, to test the dynamics and control of the system and other aspects demanded by baby devices, such as safety for the baby and resistance; and in a second step, to start an industrial development phase of the device.

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The firsta uthor wishes to dedicate this paper to his first son, Pablo Vergara, whose arrival into the world inspired the conception of this device.

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ДИЗАЈН АУТОМАТИЗОВАНОГ АДАПТИВНОГ МЕХАНИЗМА ЗА ЉУЉАЊЕ ЗА ДЕЧИЈА КОЛИЦА

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Овај рад представља ажурирани систем за љуљање дизајниран као спољни додатак који се може причврстити на већину дечијих колица, омогућавајући глатко и понављајуће кретање без потребе за ручним гурањем. Уређај је базиран на компактном механичком електричном склопу који преноси кретање кроз пар погонских точкова које покреће нисконапонски мотор. Његов дизајн има за циљ да понуди једноставно и лагано решење које се може лако инсталирати и уклонити, омогућавајући неговатељима да генеришу нежно љуљање на контролисан и аутономан начин. Техничке карактеристике механизма, његове компоненте и његов редослед рада су поново описане, заједно са критеријумима који су праћени током процеса пројектовања. Предложени систем пружа прилагодљиву структуру способну за рад са различитим геометријама колица и нуди практичну алтернативу постојећим уређајима за љуљање. Студија се фокусира на демонстрирање техничке изводљивости прототипа и успостављање основе за будућа побољшања и експериментална испитивања.