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Design of Multifunctional Yoga Massage Board

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Abstract
Aiming at the problems that modern sedentary people find it difficult to carry out effective health care due to time and space constraints, and traditional health care equipment has single functions and poor portability, this paper develops a portable foldable multifunctional yoga massager. By integrating the functions of back-pressing stretching, airbag massage, and upper limb strength training, and adopting scissor-type folding, nested, and modular designs, the balance between functional diversity and portability is achieved. The physical verification shows that the volume of the equipment after storage is only 40% of that in the use state, and efficient health care can be completed within 15 minutes. It meets the needs of fragmented scenarios such as offices and families, and provides a practical solution for the prevention of occupational diseases in sedentary people.

Keywords: *scissor mechanical structure; Yoga Massager; Portable Design; Multifunctional Integration.*

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I. PROJECT BACKGROUND

In contemporary society, sedentary work has become a common work mode. More than 60% of workplace workers have less than 30 minutes of daily exercise, leading to weakened muscles and stiff joints. 40% of those people suffer from scoliosis, and more than 70% have muscle strain. Sedentary behavior has even been listed by the World Health Organization as one of the top ten causes of death and disease.

At the same time, home fitness equipment doesn't have enough functions. For example, yoga mats, stretching equipment, and massagers need to be purchased separately. Moreover, large-scale equipment occupies a lot of space and has poor adaptability.

Therefore, we have designed a "portable foldable multifunctional yoga massager", which integrates functions such as yoga exercise, scientific stretching, and precise massage. It is suitable for limited space. With the high cost-effectiveness, it mitigates the market gap, creates an intelligent healthy lifestyle for people, and helps to cope with modern health challenges.

II. PROJECT PLAN

2.1 OVERALL DESIGN FRAMEWORK

The project adopts a design structure of "three major modules + core mechanism", following the principles of "integratable functions, foldable form, and adaptable use". Each module is connected through standardized interfaces and can be used independently or in combination. The specific framework is shown in the table below:

Module Category	Core Composition	unctional Positioning
Foldable Arm-Extending Stretching Structure	Nested structure, escapement, cable puller	Support exercise & relaxation; ensure storage & portability
Arc-Shaped Scissor Stretching Device	Scissor-type stretching device	Realize back longitudinal stretching; fit spine curve
Airbag Massage Module	Removable airbag, diaphragm air pump	Achieve back pulsed massage

2.2 FOLDABLE ARM-EXTENDING STRETCHING STRUCTURE

The outer barrel serves as the basic supporting component of the entire structure. It is the main activity platform during use and also provides the necessary support for people's use. In addition, the bottom of the outer barrel is usually equipped with anti-slip foot pads to further enhance the grip of the equipment on the ground, prevent displacement during exercise, and ensure user safety.

The internal arm-extending mechanism realizes the nesting logic through the sliding table and can be unfolded during use, taking into account both portability and functional diversity. Inside the mechanism, the escapement mechanism arranged at the lower end of the rotating pair unfolds the arm-extending mechanism and locks it with the internal stator. While increasing the exercise methods, the cable puller is connected and fixed with the universal bracket, and the rotating pair is also connected and fixed with the universal bracket, providing more flexibility and more options for users.

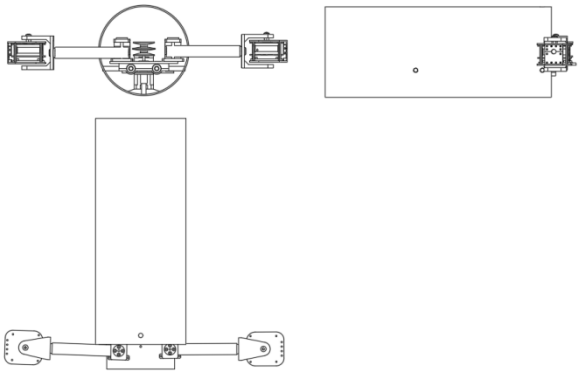

Figure 1: Module Category

2.3 ARC-SHAPED SCISSOR STRETCHING DEVICE

Outside the outer barrel, there is a set of scissor devices and corresponding massage devices. The quick-release design is adopted to realize quick separation and assembly with the main body of the massage yoga board. This not only meets the space requirements during storage but also satisfies people's diverse relaxation needs.

Through the modular design, the scissor device can be freely combined with other functional modules of the yoga board. For example, in the daily yoga exercise scenario, users can only keep the main body of the yoga board and the arm-extending cable puller; when relaxation is needed after exercise, the scissor stretching and massage modules can be quickly installed. This flexible combination method enables the equipment to be adapted to various scenarios such as home fitness and office relaxation, significantly improving the use value and coverage of the equipment.

The upper scissor design adopts a bionic design, with an overall arc-shaped structure that simulates the natural curvature of the human spine. This allows people to achieve sufficient waist stretching during the relaxation process and solve the fatigue problem caused by prolonged sitting.

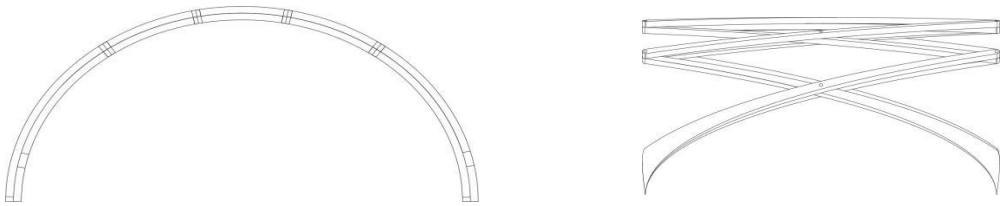

Figure 2: Schematic Diagram of the Structure

2.4 AIRBAG MASSAGE MODULE

The massage mechanism consists of three parts: a massage head, a transmission mechanism, and a control module. The massage head is made of silica gel or elastic material to provide a comfortable massage experience; the air pump provides the power source for massage. Compared with the common mechanical solutions, it provides a softer massage experience and has a smaller volume and weight; the control module integrates a circuit board and is connected to the user's mobile APP through a Bluetooth module. Users can control the module through the mobile phone to select the massage mode, adjust the massage intensity and time, so as to achieve the purpose of relaxing the body and mind.

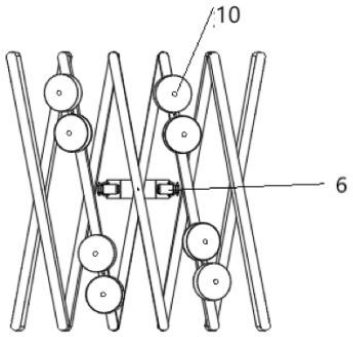

Figure 3: Airbag Massage Module

III. PHYSICAL VERIFICATION

3.1 Determination of structural parameters

By arranging a 50-120 cm supporting cylinder along the axis of the barrel on the guide shaft, the unfolding height of the arc-shped scissor stretching device is 20-50 cm; in terms of load capacity, the overall load-bearing capacity is designed according to 100 kg, the maximum pulling force of the arm-extending cable puller is 300 N, the maximum bearing force of the arc-shaped scissor stretching device is 200 N, and the pressure of the massage head is 5-20 N; in terms of movement speed, the telescopic speed of the sliding table is 5-10 cm/s, and the stretching speed of the arm-extending cable puller is 8-15 cm/s, ensuring stability and safety.

3.2 Airbag Massage Module

The massage system includes 3 groups of independent airbags (size: 15 cm × 8 cm), which are pasted on the back-pressing mechanism through Velcro, and their positions can be adjusted according to the acupuncture points on the user's back. The inflation and deflation component is composed of a 12V diaphragm air pump (flow rate: 1.2 L/min) and a two-position three-way solenoid valve. It is connected to the mobile applet through a single-chip microcomputer to adjust the inflation pressure (0.05-0.15 MPa) and cycle frequency (1-3 times per second). Three massage modes (gentle, standard, and strong) are preset, and users can switch between them through physical buttons or mobile APP to meet different massage needs.

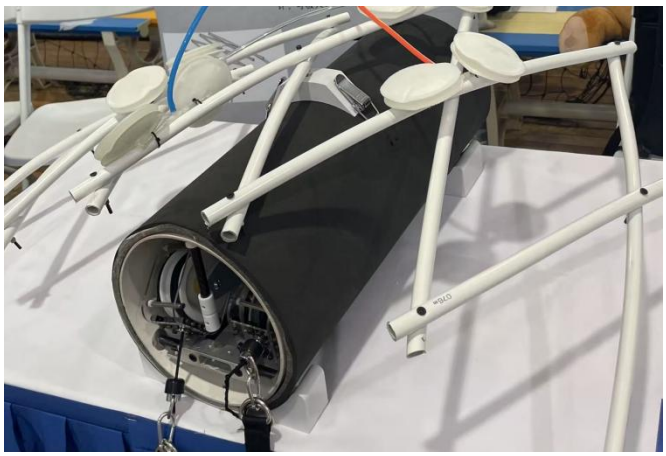

Figure 4: Physical Rendering

IV. CONCLUSION

Through demand analysis, scheme design, and physical verification, this project has successfully developed a portable foldable multifunctional yoga massager suitable for the fragmented health care needs of sedentary people.

In terms of design, by adopting storable, foldable, and detachable designs, it breaks through the single and fixed form of traditional yoga equipment, realizes flexible switching of multiple modes, and takes into account both use and storage needs. The product integrates multiple functions such as yoga, stretching, and massage, covering the needs of multiple scenarios. Users do not need to purchase a variety of equipment to meet their daily training needs. The outermost arc-shaped back-pressing mechanism and airbag massage mechanism

adopt a detachable modular design to improve practicality. At the same time, compared with traditional linear equipment, it is more in line with ergonomics and provides a better relaxation effect.

With the core advantages of "integrated functions, foldable form, and convenient operation", the equipment fills the gap in the market for integrated equipment combining "active exercise + passive relaxation + portable storage".

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