

# The Design of an Air Rower That Can Purify Indoor Air

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## Abstract

To solve the problem that utilizing an air rower lowers indoor air quality due to the dust stirred up in the course of rowing, an air rower is designed to have the extra function of air purifying. The designed rower is composed of six parts, which are the frame, air generator, transmission part, air purifying filter cartridge, performance monitor, and electric motor. To fulfill the task, the filter cartridge is vertically arranged to lead the air to enter from the lower part and vent out of the upper part to filter and purify the air before it enters the generator so as that the indoor air is well circulated to improve the air purification effect when the rower is utilizing. The modular detachable design allows the air filter and electric motor to be installed and disassembled to adapt to different air purification needs. The designed rower has the benefit of lower purchasing cost and energy saving that may motivate exercising, bringing more fun and the sense of accomplishment.

## Keywords

Air Rower, Air Quality, Purify, Modular Design, Benefits

## 1. Introduction

As living standards continue to improve, the pursuit of a healthy lifestyle is also becoming increasingly strong. Fitness, as an effective way to pursue health, has gradually entered people's daily lives. In recent years, gym and home fitness market in China has also developed rapidly as a result. Rowers, one of the most common fitness equipment in gyms and homes, have become one of the most popular fitness equipment [1]. Rowing is an efficient full-body exercise that can exercise more than 80% of the muscle groups of the whole body, including the legs, back, arms and core muscles and effectively improve cardiopulmonary function. Compared with such exercises as running and riding, rowing has less

impact on the joints and suitable for people of all ages. In addition, rowing is an effective aerobic exercise that can help burn calories and reduce fat. Studies have shown that 30 minutes of rowing can burn 500 to 800 calories. Rowers can also be folded for storage to save space, which makes it more and more popular for home exercisers. According to GIR (Global Info Research), the global rowing machine revenue was approximately USD 245.7 million in 2023 and is expected to reach USD 334.3 million by 2030, at a CAGR of 4.5% from 2024 to 2030. And the home segment accounts for around 60% of the global rowing machine market share [2].

According to the different ways of generating resistance, rowers are divided into air rowers, water resistance rowers, magnetic resistance rowers, hydraulic rowers, etc. Among them, air rowers are favored by professional athletes and many home exercisers due to their realistic, adjustable, durable, and easy-to-maintain resistance, as well as their accurate data feedback and wide range of applications [3]. But an air rower can result in the rapid flow of air, which stirs up the dust in the room and lowers the indoor air quality.

More and more people are paying attention to the air quality and purchase air purifiers to remove smog, formaldehyde and other decoration pollution, as well as pet hair, allergens and odors in the home. China's online air purifier market in 2024 is witnessing double-digit high growth for the first time in many years. The data from All View Cloud shows that in the first quarter of 2024, the online retail sales of air purifiers have reached RMB 970 million, a year-on-year increase of 16%, the retail volume has reached 630,000 units, a year-on-year increase of 24%, and the offline retail sales have reached RMB 150 million, a year-on-year increase of 4%, the retail volume reached 40,000 units, a year-on-year increase of 6% [4].

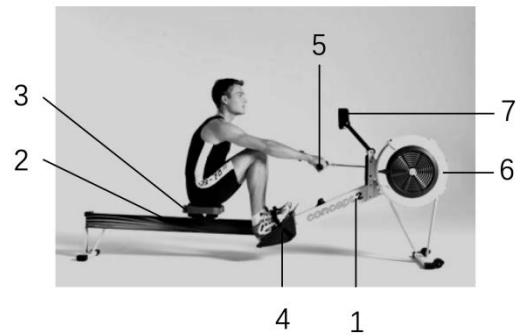
An air rower with air purifying function can ensure the indoor air quality and reduce the cost of purchasing and running a separate air purifier, which will be welcomed by consumers in the market.

## 2. Design Philosophy

An air rower with air purifying function is designed to deal with its downside that when being utilized it stirs up the dust around and then leads to poor air quality. Such air rower can not only exercise the body but also meet the green concept of energy saving, environmental protection, and air purification [5].

### 2.1. Construction of an Air Rower and Its Downside to Lower Air Quality

An air rower consists of 7 parts as shown in **Figure 1**. The frame, labeled as number 1, is the foundation of the rower, which is made of aluminum or steel frame and provides stability and support. It is the foundation frame for installing other parts. The track, labeled as number 2, is the track on which the user slides back and forth. It is made of aluminum or steel, with a smooth surface to reduce friction. The seat, labeled as number 3, is the position where the user sits. It is



**Figure 1.** Components of an air rower.

made of a piece of hard elastic plastic board, which can provide comfort and support. There are rollers under the seat to slide along the track. The foot pedals, labeled as number 4, are the positions where the user places their feet. They can be adjusted to suit different heights and shoes. The handlebars, labeled as number 5, are the handles used by the user to row on the rower. They are made of aluminum or steel, with frosted plastic added on the surface to provide moderate friction for easy grip. The handlebars are connected to the gears on the air generator through a chain, which drives the impeller to rotate. The air generator, labeled as number 6, is the device providing resistance. It consists of a metal can with an impeller. When the user rows, the impeller blades rotate, generating resistance. The resistance of the air generator can be adjusted by the damper at the air inlet to suit users of different levels. The performance monitor, labeled as number 7, is the device displaying exercise data on the rower. It can display data such as speed, time, distance, and stroke rate. The performance monitor can be connected via Bluetooth to a heart rate monitor chest strap or smartphone or tablet to enhance the user experience through related apps.

Air rowers often have two downsides. One is that the air generator will generate noise [1]. The level of noise depends on the speed of the impeller and the speed of air flow. The higher the impeller speeds and the faster the air flow, the louder the noise is. The second is that the air generator sucks in air from the side and then throws it out from the surroundings, leading to the rapid flow of air, which will stir up the dust in the room. The faster the air flow is, the more dust will be in the air, which will reduce the indoor air quality.

Air rowers lead to an increase in dust and particles in the air although they generally do not cause indoor air pollution problems. The working principle of an air rower is to use air resistance to generate resistance. When the user rows, pulling the handle bars will drive the chain to rotate the impeller, as a result the air enters from the air inlet and is discharged from the exhaust port. In this process, dust and particles in the air and on the ground are stirred up and suspended in the air. If the indoor air quality is poor or there is dust, pet hair, dander, etc. on the ground, utilizing the air rower can lead to the increasing concentration of these pollutants in the air, which may cause health problems for people with sensitive respiratory tracts, such as allergies, asthma, etc. [6]. In

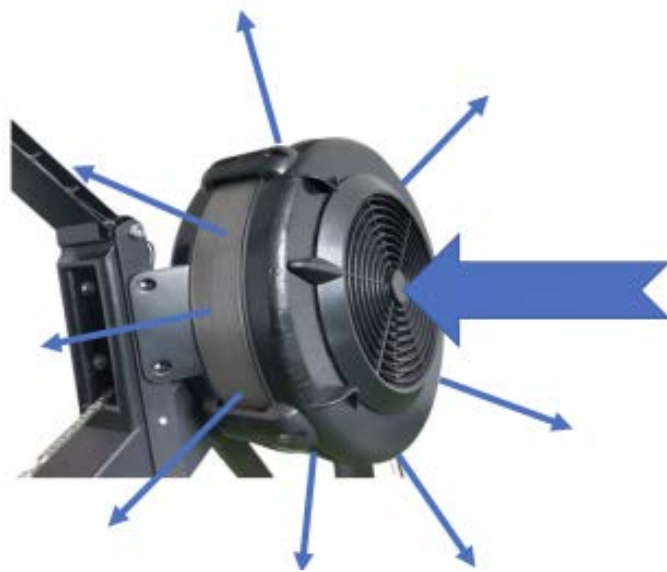
addition, when there exist other factors affecting indoor air quality, such as cooking or smoking, utilizing the rower will definitely make the indoor air quality much poorer.

## 2.2. Design Idea

How air flows the rower's air generator is demonstrated in **Figure 2**.

Air enters the air generator from the air inlet, is adjusted by the damper, and then passes through the rotation of the impeller to be discharged from the metal mesh on the side. Most of the air purifiers on the market are filter-type air purifiers, which use the built-in filter to filter out pollutants in the air to achieve the purpose of purifying the air. The purifying involves three steps in a continuous cycle. At first, the fan rotates to make part of the air in the air purifier chamber discharge from the exhaust port, creating negative pressure in the air purifier chamber; next, indoor air enters the machine chamber through the filter, and the filter will intercept and absorb pollutants in the air; and then the air that has been filtered and purified through the air purifier chamber is discharged from the air outlet. It is obvious that the air generator of the rower and the air purifier have a high degree of fit. From the perspective of air circulation, they both need to go through the process of the indoor air being sucked into the machine chamber and then discharged.

Based on the fit, a filter cartridge can be installed at the air inlet of the air generator to achieve the purpose of air purification with the air flow of the air generator. Given the indoor air circulation, to guarantee the air purification effect the air generator needs to be put horizontally above the air filter cartridge from which the air is sucked in, and a cowling is used to cover the air outlet of the air generator, which discharges the air upward to well circulate indoor air to improve the air purification effect.

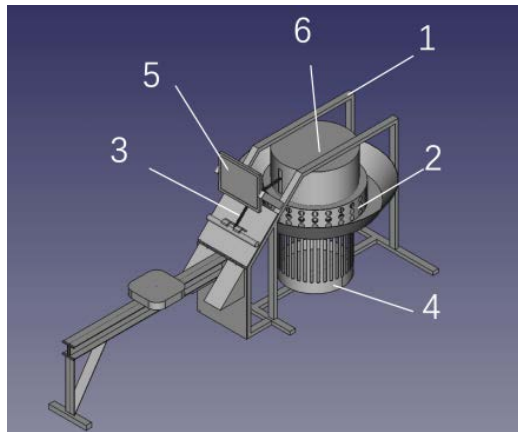


**Figure 2.** Airflow through the air generator.

### 3. Design Scheme and Its Benefits and Limitations

#### 3.1. Design Scheme

The air rower with air-purifying function is designed to consist of 6 parts as shown in **Figure 3**.



**Figure 3.** Main structural components of an air purifying air rower.

The frame, labeled as number 1, is divided into a front half and a rear half. The front half supports the filter, air generator, performance monitor and such transmission part as chain and sprocket of the air purifier. The track and seat are installed on the rear half. The two parts can be firmly combined with hooks and buckles and can be separated and stand up to reduce the storage space.

The air generator, labeled as number 2, is installed horizontally on the frame, and is connected to the air purification filter cartridge at the bottom. A circle of funnel-shaped air deflector is installed around the air outlet of the air generator. The design of the air generator itself is the same as that of a general rower air generator.

The transmission part, labeled as number 3, are used to drive the impeller to rotate and stretch the rear chain to return to position which includes the handle, chain, the gears inside the outer cover of the host machine that is labeled as number 6, 90-degree right-angle transmission reversing umbrella gear box, elastic rope, etc.

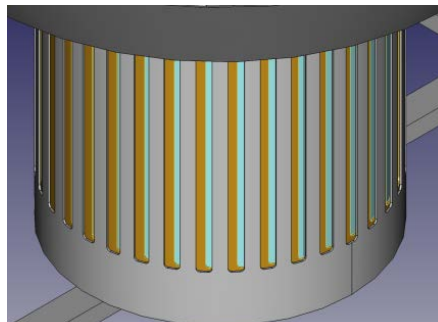
The air purification filter cartridge, labeled as number 4, includes a metal cartridge and an air filter, which can be tightly installed on the air inlet of the air generator. The filter adopts a three-layer structure as shown in **Figure 4**. The outermost layer is the primary filter, which is used to intercept larger particles in the air, such as dust, hair. The middle layer is an activated carbon filter, which has strong adsorption ability and can absorb harmful gases in the air, such as formaldehyde, benzene, ammonia. The innermost layer is a HEPA filter, which can intercept more than 99.97% of particles larger than 0.3 microns in the air, including PM2.5, PM10, bacteria, viruses. Each layer of the filter can be cleaned or replaced separately according to its usage and service life. The air rower ad-

justs the resistance by adjusting the size of the air resistance. The size of the air resistance depends on fan speed, air intake volume, shape and angle of fan blades. The faster the fan speed is, the greater the air resistance; the greater the air intake volume is, the greater the air resistance. On this basis the resistance can be adjusted manually through controlling the air intake volume or automatically based on the rower's speed or power. Therefore, the air purification filter cartridge uses a double-layer structure, with ventilation holes on both the inner and outer walls of the double-layer cartridge. The relative rotation of the double-layer cartridge will cause the size of the ventilation holes to change to control the air intake volume as displayed in **Figure 5**, where half of the air inlet is blocked, which allows users with different training needs to adjust the resistance to achieve more effective exercise.

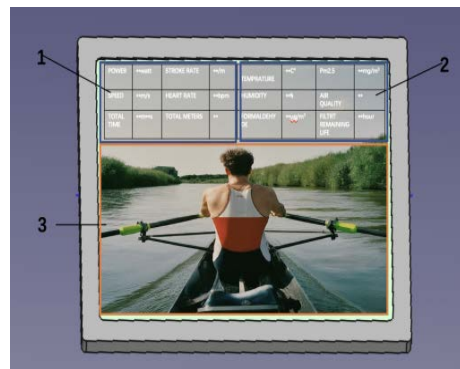
The performance monitor, labeled as number 5, besides being able to monitor the performance of fitness such as power, speed, time, distance, stroke rate, etc., should also display whether the air purification module is working normally, whether the air quality is good, temperature, humidity and PM2.5 value, etc., the condition and remaining life of the filter, reminding the user to replace the filter, and other interesting and entertaining content and design [7]. The interface of the performance monitor is shown in **Figure 6**. The display area labeled as number 1 gives the information of the performance of fitness, the display area labeled as number 2 gives the information of air condition, and the display area labeled as number 3 gives the information of interesting and entertaining content.



**Figure 4.** The structure of the filter.



**Figure 5.** Adjustable filter cartridge.



**Figure 6.** The interface of the performance monitor.

The electric motor is enclosed in the outer cover of the host machine, labeled as number 6, above the air generator and is used to connect the drive shaft of the impeller to provide power for air purification when no one rows. The motor has a controller that can start or stop the motor, the running time and speed, etc.

Since the air purification function needs to be based on the user's actual needs, a modular design is adopted, which allows it to be installed and disassembled as needed. When the user does not need to purify the air, the air filter and electric motor don't need to be installed. When the user needs to purify air during rowing, only the air filter needs to be installed. When the user needs to purify the air only without rowing both air filter and electric motor need to be installed.

### 3.2. Benefits and Limitations

This design brings the air rower five benefits.

First, it solves the problem that the utilizing air rower stirs up dust and leads to poor indoor air quality and ensures fresh indoor air. Secondly, it saves the cost of purchasing an air purifier. Thirdly, it saves the energy of running an air purifier. As a result, saving energy may motivate the exerciser to row, which brings the exerciser more fun and the sense of accomplishment beyond rowing to exercise. Last, the modular design improves the flexibility, which allows the user to flexibly make use of the purifying function.

This design has three limitations. First, it increases the complexity of a rower, which will increase the purchasing and maintenance costs. Next, when the indoor air quality is so poor that long-time purification is required, the designed rower needs to be equipped with an electric motor drive module. Thirdly, because it integrates the rower and the purifier together, it is not as flexible as a separate air purifier that can be easily moved to the desired room.

## 4. Conclusions

On the basis of the existing air rowers in the market, an innovative design has been made to deal with the problem that utilizing a rower lowers the indoor air quality.

Based on the fact that air rowers cause air disturbance to lower indoor air quality, air purification filter cartridge is installed at the air inlet of the air generator to purify the air and it can also maintain the cleanliness of the interior of the air generator. Because the air purification filter cartridge has a certain length, and considering the effect of air purification, the air generator and the air purification filter cartridge are arranged vertically. A 90-degree right-angle transmission reversing umbrella gear box is used to combine the vertical rotation of the chain-driven gear with the horizontal rotation of the impeller of the air generator. The different cross-positioning of the air holes on the inner and outer walls of the double-layer cartridge of the filter cartridge will cause the size of the air holes to change, so as to control the air intake and allow users with different training needs to adjust the resistance according to their own training needs. Through a modular design, the filter and electric motor of this fitness equipment can be purchased and installed according to actual needs.

To sum up, this designed rower with the extra function of air purifying gives the benefits of cost-and-energy saving and brings more fun and a sense of accomplishment beyond rowing, not only realizes the function of rowing, but also has the function of air purification. It is flexible and reliable in actual operation and use, and the purchasing cost is lower than that of purchasing a rower and an air purifier separately, which promises a certain market promotion and use value.

### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

### References

- [1] Shi, W. (2018) Rower: A Weapon for Full-Body Exercise. *Sports Goods and Technology*, **5**, 22-24.
- [2] Global Info Research (2024) Research Report on the Overall Size, Major Manufacturers, Major Regions, Products and Application Segments of the Global Market in 2024. <https://www.globalinforesearch.com.cn/reports/1206403/rower>
- [3] Ying, C., Fan, Z. and Li, B. (2023) An Analysis of the Quality and Standardization Status of Indoor Rowing Machine Products. *Quality and Standardization*, **8**, 50-53.
- [4] China Economic News Network (2024) After Seven Consecutive Years of Decline in Scale, the Air Purifier Market Finally Welcomed the Long-Lost Growth. <https://www.cet.com.cn/itpd/jd/10065970.shtml>
- [5] Cui, M., Shen, X. and Dong, Y. (2021) An Environmentally-Friendly Air Purification Exercise Bike. *Science and Technology Innovation and Application*, **11**, 32-35.
- [6] Li, H., Liu, X., Chen, H., Ding, W. and Luo, X. (2022) Design and Experimental Study of Multi-Functional Air Purifier. *Machine Design and Research*, **1**, 230-235.
- [7] Li, Z. and Liu, C. (2023) Research on Innovative Design of Home Rowing Machine Based on KANO-QFD Model. *Art and Design*, **11**, 117-120.