

Maze exergame applied to IoT-based tiny aerobic equipment

CHIEN-HSIEN YEH^{1*}, SHEN-HUNG LIN¹

1. Medical Device Innovation Center, National Cheng Kung University, Taiwan.

* Presenting Author

Abstract: The tiny aerobic equipment is a well-known exercise device. There are some parameters, such as the cycle count, calories consumption, biking distance, et al., displaying on the built-in LCD screen. In general, the rate of equipment utilization is low due to the tedious experience. This study induced a maze exergame in the exercise to enhance the motivation. The exergame was performed in the Android operation system and the maze rotation corresponded to the motion of the tiny aerobic equipment. A Bluetooth module was integrated to transmit the exercise data, such as the rotation speed and the calories consumption. This study used three Hall sensors to detect the rotation direction and speed of the tiny aerobic equipment. And the calories consumption would be estimated using an experimental model of power loss and it is proportional to the rotation speed and the covered area of magnet resistor. The gamification means were applied to this study not only to activate the motivation but also reveal the serious exercise state in entertainment.

Keywords: Aerobic equipment, Bluetooth, Calories consumption, Magnet, Gamification.

1. Introduction

The tiny aerobic equipment looks like a small bike (Fig. 1). It is common in every long-term care center. Most users are the elderly. This kind of exercise device can work on the table and ground which is used to train the upper and lower limb respectively. But the exercise device is tedious so the rate of equipment utilization is usually low.

The gamification applied the game logics and means to our serious activity [1]. To improve the tedious situation when using the tiny aerobic equipment this study developed a maze exergame which is performed in Android operation system. Through the Bluetooth module, Hall sensors, and an embedded system we made an IoT-based equipment. All the exercise data, such as the rotation speed, is transmitted to the platform using Android operation system. Thus the maze rotation can correspond to the motion of the tiny aerobic equipment.

The calories consumption is related to the power output of the equipment. The power is the function of the material characteristics (C), magnet field density (B), rotation speed (ω), and affected conductor area (A). According to Waloyo et al. [2] the torque of the tiny aerobic equipment can be represented as equation (1).

$$T = f(B, C) \cdot R^2 A \omega \quad (1)$$

where R is the distance from the center of cycling plate to the affected conductor area. The torque T would be determined by the rotation speed after the calibration. And furtherly referring to Hill et al. [3], the calories consumption is four times of the power loss.

2. Results and Discussion

This study set up the said sensors and modules in a commercial product (Fig. 1). Ant the exercise data was transmitted to the TV screen, pad, or smartphone by Bluetooth. The maze rotated with the information of the equipment motion. The serious activity was revealed in entertainment.

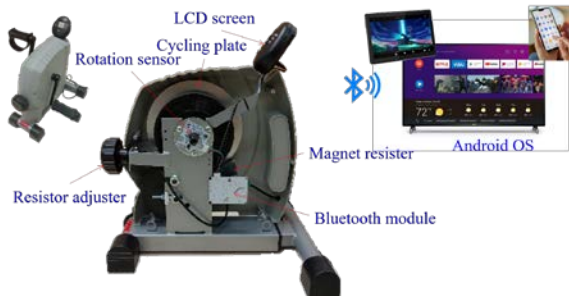


Fig. 1. The tiny aerobic equipment combined the rotation sensor and an embedded module which transmitted the exercise data to a platform using Android operation system, such as the pad or smart phone.



Fig. 2. The maze rotation corresponded to the motion of the tiny aerobic equipment, and the exercise state revealed after playing.

3. Concluding Remarks

This study developed an IoT-based tiny aerobic equipment and associated exergame to improve the tedious experience.

Acknowledgment: This work was financially supported by the Medical Device Innovation Center (MDIC), National Cheng Kung University (NCKU) from the Featured Areas Research Center Program within the framework of the Higher Education Sprout Project by the Ministry of Education in Taiwan.

References

- [1] MATALLAOUI, A., ET AL., HOW EFFECTIVE IS "EXERGAMIFICATION"? A SYSTEMATIC REVIEW ON THE EFFECTIVENESS OF GAMIFICATION FEATURES IN EXERGAMES. *Proceedings of the 50th Hawaii International Conference on System Sciences*, 2017. P. 3316-3325
- [2] WALOYO, H.T., ET AL., A NOVEL APPROACH ON THE UNIPOLAR AXIAL TYPE EDDY CURRENT BRAKE MODEL CONSIDERING THE SKIN EFFECT. *Energies*, 2020. **13**: P. 1561
- [3] HILL, A.V., THE MAXIMUM WORK AND MECHANICAL EFFICIENCY OF HUMAN MUSCLES, AND THEIR MOST ECONOMICAL SPEED. *The Journal of physiology*, 1922. **56**(1-2): P. 19-41.