

Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Invention)
(Word Limit: 1,000 words, Pages: 2 pages only)

Team Number: JAPE284

Project Title: Pongwer

Project Type: Invention

To our best knowledge and after thorough literature research, as at 2022/19/6, there are no* similar works. If there are, the reference links are as below:

N/A

The enhancement our project has made for the existing related products or research is summarized as below:

N/A

***Please delete if not applicable. HKSSPC values the originality of works. Students must conduct literature research thoroughly to ensure that their works are unique, and to list relevant reference materials to complement the research or invention.**

I. Background

- Provide background information as to learn about the audience for whom the project is addressing
- Provide highlights of **literature review** and/or related technologies or devices, with the support of pertinent and reliable references
- Provide an overview of work, create a point of view as to define the needs and insights of the audience and mention the **research or technology gap the project is trying to fill**

We have *two major problems* to tackle with: lack of exercise and non-renewable energy. According to a CUHK Survey ([link to article](#)) in 2013, in 2,744 Hong Kong citizens aged between 18 and 75, only 50% of the respondents performed 'regular' exercise (defined as exercising at least two times a week, each time lasting 30 minutes or more) while 6.4% of respondents didn't perform any exercise.

According to Hindawi (<https://www.hindawi.com/journals/je/2013/845051/>), approximately 40% of global CO₂ emissions are emitted through the combustion of fossil fuels to generate heat that power steam turbines. While fossil fuels will eventually deplete, our project is to create new renewable energy sources with sports, as an attempt to solve both problems at once.

II. Objectives

- State the **aim(s)** of project
The aim is to *generate power* by converting the *mechanical pressure* exerted on the table tennis racket to *electricity* as a renewable energy resource. It promotes the concept of using sport to environmentally friendly generate electricity. We hope this motivate more people to participate in sport.

III. Methodology

- Briefly describe the **approaches** used e.g. use of equipment, materials, tests and experiments
- Explain the selected implementation strategies with the **scientific theory**

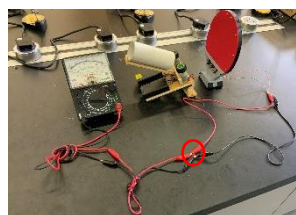


Figure 1: The set up of the experiment

Figure 1 shows the whole set of apparatus. The leftmost one is a voltmeter (multimeter). The rightmost one is the Pongwer. In the middle, it's a self-made table tennis launcher to simulate the shock on the table tennis racket. A tiny LED (circled in red) is connected in parallel to the voltmeter to visualize the generated voltage.

We have utilized the *piezoelectric effect*, which is the ability of a certain materials to *generate an electric charge* in response to *applied mechanical stress*. Therefore, the case of the Pongwer is constructed with *plastic* as it is both rigid and flexible enough to transfer mechanical stress to the inner piezoelectric transducers.

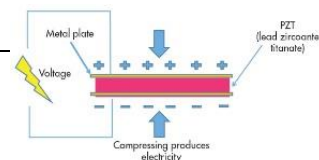


Figure 2: A diagram about piezoelectricity

IV. Design of Invention

- Describe the **design** and the **principle** of invention (e.g. The ideation of the projects, the prototypes or creative solution as far as applicable)
- Provide sketches / drawings / photos of the invention

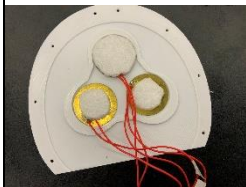


Figure 4: Interior of the racket

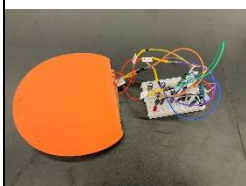


Figure 5: Pongwer Proto

The inspiration of Pongwer actually came from a simple question: can we generate electricity with sports equipment? The answer is definite yes. We associated the interaction between the table tennis and its racket with piezoelectricity, so that we came up with Pongwer— a table tennis racket electricity generator.

Originally, we have decided to connect the 3 ceramic piezoelectric transducers (Figure 4) with a single diode bridge, wishing that the “AC” generated voltages from the transducers will be rectified. However, the traditional configuration is not effective to handle small generated voltages and the “AC” waves may interfere in one another.

After a while of researching, we found the ideal circuit (Figure 3) for the project online ([The Instructables article link](#)).

The *Villard Cascade (half-wave series multiplier)* has the advantage of *amplifying the rectified voltage with only small energy loss*. In contrast, the *diode bridge* configuration has a 20% energy loss. We set up the circuit and conduct experiment on a breadboard. We also design a 3D-printed case in a table tennis racket appearance to cover the transducers (Figure 5) to emphasize our theme.

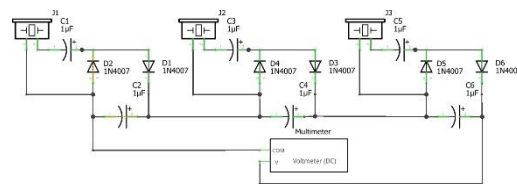


Figure 3: Schematic of Pongwer

V. Application / Market Need

- Explain the area of **application** and function of invention
- Indicate the market need and impact of invention
- Discuss **limitation** and compare with existing related works (if any)

Our ultimate objective of this project is to generate sufficient electricity to be stored in a capacitor, even possible to charge a phone by playing table tennis. We hope Pongwer can encourage everyone to do more exercise in exchange of charging your devices, saving the environment while remaining healthy physically and mentally.

At this moment, they are only ideas. In reality, Pongwer can generate the voltage of an AA battery (approximately 1.5V or less), it has been a limitation of its unlimited possibilities and applications.

VI. Conclusion

- Make a **data-driven** conclusion of the project and the way forward of the invention process
- Justify if the proposed project meets the objective(s)

As Pongwer can only generate a *maximum of 1.5V*, it has not fully met the objective mentioned. We look forward to finding ways to magnify generated voltage for our proposed objective.

Our project is developed based on our school's previous project and the enhancement is as below:

N/A