

Innovation and Technology in Table Tennis

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Abstract. The advancement of innovation and technology has been seen in table tennis for many years; for example, developing the racket design with the innovation to make its weight lighter for better control, using the innovation for training in the form of robot to enhance the player's reaction, accuracy and footwork. Moreover, a variety of technologies can help broaden the player's skills to make the game more exciting and challenging as well as to gain more experience for entertainment in every level. The innovation and technology in table tennis has been still developed gradually, especially seeking for something new to facilitate the player's training such as the robot available for playing interaction with the player, innovation for data analysis to clarify the information for performance improvement, and technology for experience promotion with playing simulation program, etc. It can be said that nowadays innovation and technology have a significant effect on table tennis, particularly transformation from an indoor sport to a high – tech game for better experience of interested persons. In the future it is expected that innovation and technology will create a challenge in various forms and enable everyone to reach the game in various convenient ways.

Key words: table tennis, equipment for playing, innovation and technology, training, entertainment

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INTRODUCTION

Table tennis or “Ping Pong” has got a long history since the end of the 19th century and has been developed with a variety of innovations to brush up the style and experience of playing in challenging ways. The style of playing table tennis has been evolved from Parlour Table Games, the game with featured strung rackets, a 30mm cloth covered rubber ball, a wooden fence set up around the perimeter of the table, and large side nets extending along both sides. Also, it was applied from the game, “Gossima”, the shuttle cock game with a 50mm Cork ball, a net in 30cm height, a calf leather drumstick and a white belt secured a large wooden net to the table. During 1900 – 1992 James Gibb, an English engineer, created a 38mm celluloid table tennis ball used instead of the former one until 2014. Since then, the material used for the ball has been changed again from a celluloid ball to a plastic ball (International Table Tennis Federation, n.d.).

Many things in table tennis have been developed continuously, especially the table tennis racket most upgraded from the 1902s until the beginning of the 1970s. Rubber was pasted on the racket side used for hitting the ball along with sponge on the rubber based on the concept of Yin – Yang, one side with Pimples-in and another side with Long-pimples. Discovering speed glue, the glue for bicycle, was able to promote more speed and spin for the ball. However, rules and regulations including equipment for playing must be certified by International Table Tennis Federation. Many changes happened; for instance, establishment of ordinary pimples rubber thickness in 1959 – 1960, international standardization of the rules for the rubber color on both sides of the racket, Red and Black, in 1985, prohibition of long-pimples and speed glue with Volatile Organic Compounds/VOCs in all events of youth competition during 2006 – 2008 (International Table Tennis Federation, n.d.; International Table Tennis Federation, 2020; Alex Horscroft, 2022; Greg Letts, 2018; Ben Larcombe, 2015.).

Innovation and technology in table tennis have been created more and more to facilitate the player's training; for example, the Ping Pong Robot to Return a Ball Precisely by Omron (2020) which integrated the industrial technology to produce the robot available for playing table tennis with the human, and Fast Pong Table Tennis Training System by Amir Kamandi (2019) to enable the players to enhance their agility, accuracy and motor coordination.

In addition to the table tennis equipment and innovation serving the player's training, the technology for entertainment has been constructed for interested persons. It is a kind of technologies using Application on a smart phone or a tablet to enable the new generation facing new ways of life and social, cultural, economic and environmental changes, particularly technology influencing the life style and relationship in the digital world to gain more experience in playing table tennis. It is believed that technology will be beneficial to create sports activities and attract people to participate in those activities with innovation on equipment for playing, style of playing or whatever for continual development of table tennis.

Equipment for Playing Table Tennis

International Table Tennis Federation created the manual published in Switzerland in 2022 in order to inform the changed rules and regulations to meet the international standard. One of the important changes is that the equipment for playing must be certified by International Table Tennis Federation. If there is no I.T.T.F logo on the equipment for playing, it shows no standard on that equipment. The equipment for playing comprises as follows:



Figure 1. Table Tennis Racket
From: STIGA Table Tennis. (2022).

Table tennis racket is an important equipment for the player to select to comply with the style of playing by considering the rubber and the racket. The types of rubber for selection are recommended by Ping Pong Inter. (2017a) as the following:

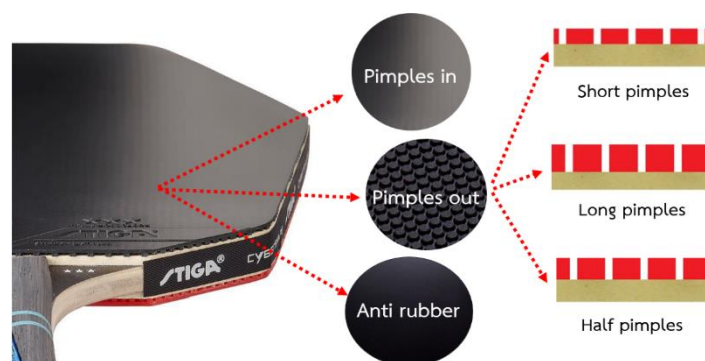


Figure 2. types of rubber
From: Stiga Table Tennis. (2022); Butterfly Thailand. (n.d.); Ping Pong Inter. (2017b).

1. Table Tennis Rubber is a kind of equipment for playing, which is glued on the racket with two colors given originally, Red and Black; however, in 2021 the additional four colors of the rubber were established and let to use for playing, Pink, Purple, Green and Dark blue (International Table Tennis Federation, 2021). The types of the rubber can be classified as follows:

1.1 Pimples-in, regarding the international rules the thickness of rubber and sponge must not be over 4mm (Ping Pong Inter, 2017c):

1.1.1 Top Sheet in two categories:

- 1) Tacky which is secured to the ball and suits for Spin
- 2) Non Tacky which suits for both Spin and Smash

1.1.2 Sponge in three components:

- 1) Softness of the sponge, the hard one can promote high speed; but, the soft one can promote the control better than the hard one.
- 2) Thickness of the sponge, the thick one can promote the speed higher than the thin one; yet, the thin one can promote the control better than the thick one.
- 3) Materials used for sponge, various materials for sponge, natural sponge or silicone sponge depending on the sponge producer.

1.2 Pimples-out, the pimples are shown outside with or without sponge, which can promote speed but may limit the spin.

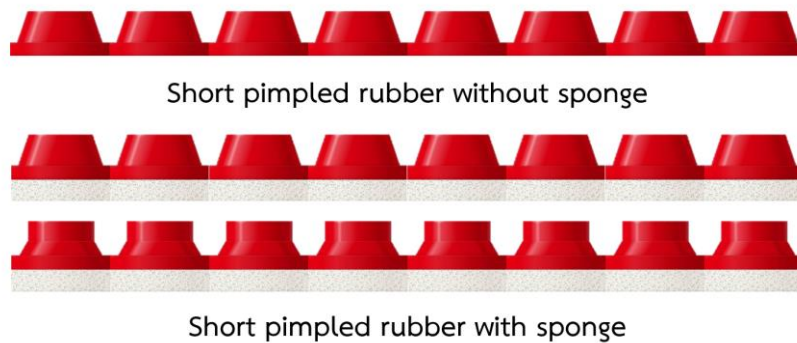


Figure 3. Short pimples rubber without and with sponge
From: Butterfly Thailand. (n.d.).

1.3 Long-pimples, the pimples are shown outside with or without sponge. The speed and control promotion of long pimples is not sure depending on the spin made by the opponent player.

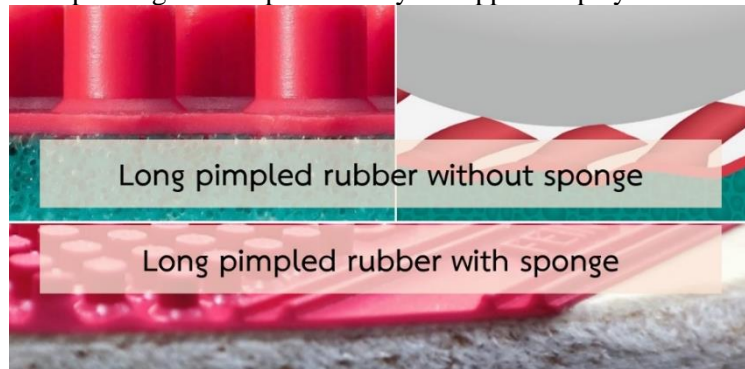


Figure 4. Long pimples rubber without and with sponge
From: Butterfly Thailand. (n.d.); Ping Pong Inter. (2023).

1.4 Half-pimples, its length is between Pimples-out and Long-pimples, the speed and control promotion of which is similar to the Long-pimples'. Normally it is categorized in Long-pimples by the rules of the International Table Tennis Federation.

1.5 Anti-Rubber, which is similar to Pimples-in but without the promotion of Spin; in other words, playing with anti-rubber will make the promotion opposite to playing with Pimples-in (Ping Pong Inter, 2017b).

2. Table Tennis Racket, International Table Tennis Federation has the rules that table tennis racket must be made from 85% natural wood and 15% can be from any other materials instead of natural wood (Ping Pong Inter, 2017d). The table tennis racket innovation is shown below:

2.1 two categories of table tennis racket

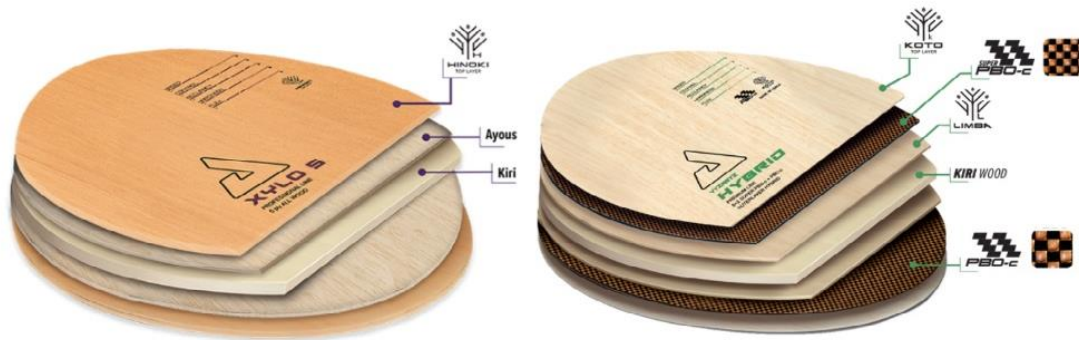


Figure 5. The table tennis racket made from natural wood and any other materials
From: JOOLA. (2021).

2.1.1 The racket made from natural wood, which is the racket with the combination of several layers of wood. The racket with many layers of wood can promote the bouncing of the ball but the wood is quite rare and in the high price (Ping Pong Inter, 2017e).

2.1.2 The racket made from any other materials, which is the racket with the combination of 85% natural wood and 15% materials which are not from natural wood. This category of racket can promote the area of bouncing.

2.2 Baking the table tennis racket at 200 degree Celsius in 24 hours can help drive the humidity and make the wood harder and denser. This way can promote better bouncing without any other materials instead of wood.

2.3 Adding gaps in the wooden racket handle can help make the weight or the weight balance point move to the head area and promote the ball moving faster and stronger.

2.4 Designing the racket to give the vibration to the player's hand can encourage the player to recognize when the ball hits the racket and estimate to effectively make the ball hitting force.

3. **Table Tennis Table** is the rectangle table in 2.74m length (9 feet long), 1.525m width (5 feet wide) and 76cm in height (2 feet 6 inches high). The ball can be bounced about 23 centimeters. The table surface must be in dark color without light reflection. The table area is divided equally with the net perpendicular to the table surface (Ping Pong Inter, 2017f). The **table tennis table** is divided as follows:

3.1 **Indoor Table Tennis Table which keeps bouncing better than Outdoor Table Tennis Table.** This type of table should avoid from direct sunlight and wet places.

3.2 **Outdoor Table Tennis Table** which is stronger and more durable than **Indoor Table Tennis Table.** This type of table has bigger wheels; also, it can be sunlight resistant and put in the wet places.

4. **Table Tennis Net** is the net which is taut and secured with a rope attached to the top of the pole. The net is established straight 15.25 centimeters high from the table surface. The bottom of the net in long line must be adjacent to the table surface. The end of the net in both sides must be closest to the pole (Ping Pong Inter, 2017g).



Figure 6. Table tennis table and net with I.T.T.F logo by International Table Tennis Federation
From: Stiga US. (n.d.).

5. **Table Tennis Ball** is in size of 40mm and weight of 2.7 grams with the symbolized number of 40+. It is made from Acrylonitrile Butadiene Styrene: ABS, instead of any other types of plastic, due to its durability, evenly roundness and bouncing promotion which is better than any other plastic balls. Star ranking of table

tennis balls can identify the quality of the ball; in other words, higher star ranking means higher durability and evenly roundness (Zeid Kaddoura, 2022).

It can be concluded that standard equipment for playing must be certified by International Table Tennis Federation, obviously seen from I.T.T.F. logo. At present, there are six colors of table tennis racket rubber consisting of Black, Red, Pink, Purple, Green and Dark blue. The table tennis table can be mainly made from wood with any other material combination and the color of the table surface must be without light reflection. The table tennis table is also divided with the net and the table tennis ball is made from Acrylonitrile Butadiene Styrene: ABS, in size of 40mm and weight of 2.7 grams with the symbolized number of 40+ only.

Innovation and Technology in Table Tennis to Facilitate the Pleyer’s Training

Innovation and technology in table tennis have been designed to enhance the players’ training in many forms in order to upgrade their skills, analyze their performance and plan the strategies for their highest potential. Particularly, the innovation in the form of robot with the senser available for analyzing data and feeding the ball to make playing interaction with the player, and the technology with Application to create a challenge for the player’s training.



Figure 7. The Ping Pong Robot to Return a Ball Precisely
From: Michael Alba. (2016).

The innovation in the form of robot available for playing interaction with the player was created by Omron. (2020) in the name of “The Ping Pong Robot to Return a Ball Precisely”. It works with the sensor system for analyzing the player’s movement and the camera over the table, which can examine the position of the table tennis ball. The robot can determine the skill level of the player by analyzing the speed, the way of ball moving, the spin of the ball, and the body movement. Furthermore, any other pieces of innovation in the form of robot are created as the assistant coach for feeding the balls as follows:

1. Pongbot M-ONE which was developed by Shanghai University of Sport and Siasun Robot & Automation Co. Ltd. The robot is available to adjust speed and serving styles, the spin and the position of ball bouncing by the Application device (He Qi in Shanghai; 2020).

2. Automatic Ping Pong Ball Machine with the Application device or the remote control to set the ball speed and spin for a variety of ball hitting skill trainings (Ping Pong Inter, 2017h).



Figure 8. Pongbot M-ONE and Automatic Ping Pong Ball Machine
From: Pombert Official Flagship Store. (n.p.); Taoyeshishena. (2020).

Apart from the innovation in the form of robot available for playing interaction with the player, the technologies with Application, namely Interactive Table Tennis Trainer and Fast Pong Table Tennis Training System, were created to make a challenge for training the player's skill and monitor the player's performance.

Interactive Table Tennis Trainer is a master work piece of Thomas Mayer in his bachelor's degree. It works with the camera over the table to monitor the ball moving together with the projector showing any movement on the table. The players have their own dashboard and all the data will be kept and displayed on the table tennis table. It is available to take a look and monitor their performance. After the game all the data will be shown to let them know how to improve for the next playing (Linn, 2020).

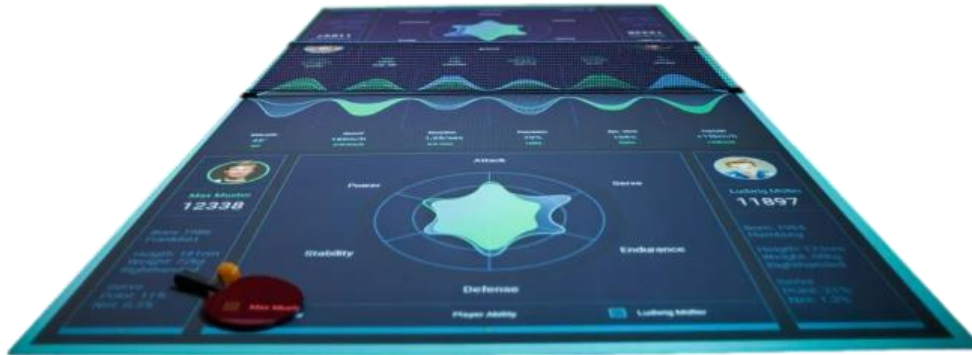


Figure 9. Interactive Table Tennis Trainer
From: Rain Noe. (2016).

Fast Pong Table Tennis Training System was created Amir Kamandi. (2019) consisting of eight square tables. At the frame of the square tables, it is available to turn on the light of dark blue or green colors upon the situation. It works with the sensor and Application device to let the players monitor their performance and analyze their agility, accuracy and motor coordination.

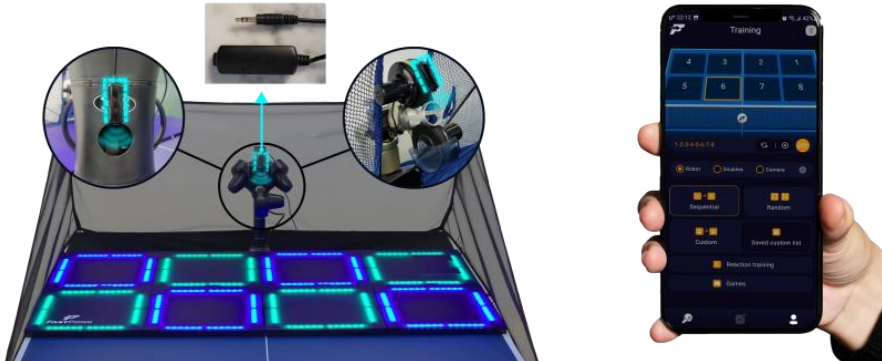


Figure 10. Fast Pong Table Tennis Training System
From: Fast Pong. (2022a); Fast Pong. (2022b).

To sum up, innovation and technology in table tennis to facilitate the player's training can not only help the players monitor their performance, and evaluate their skills for improvement; but also, some innovations can promote the analysis of speed, way of ball moving, spin of the ball and the body movement with the sensor system.

Technology for Entertainment of Persons interested in Table Tennis

One of the well-known technologies in table tennis which can give entertainment and experience to the players is called Virtual Reality Table Tennis Training, VR Table Tennis. The players can interact with the place or environment through the two-handed controller and realize anything from seeing, hearing, touching and smelling with Virtual Reality: VR.



Figure 11. Virtual Reality Table Tennis Training or VR Table Tennis
From: For Fun Labs. (2016); Pixel Edge Games. (2017).

The games which can be played with this technology comprise Eleven Table Tennis or Racket Fury and VR Ping Pong Pro. Also, another live Application named LOTTO Superliga showing Polish Super League Table Tennis of Poland, one of the highest rank of the league in the world, is an optional service given by this kind of technology to view the highlight and schedules of the game along with any statistics (Ben Larcombe, 2016).



Figure 12. Table Tennis Superliga LIVE
From: Ben Larcombe. (2016).

Interactive Asahi Projection Ping Pong Table is another kind of technology for entertainment combining the original game of table tennis with interaction projection. The special surface of the table is used to create the dynamic graphic for the ball and the players with multi functions such as ball shooting on the table, promoting the players' cooperation to accomplish their goals along with sound and music to satisfy their playing experience (Double Take Projections, 2018).



Figure 13. Interactive Asahi Projection Ping Pong Table
From: Double Take Projections. (2018).

CONCLUSION

The article highlights the current state of computer technology applications in sports, particularly in table tennis. It emphasizes the limited use of sports calculation and the scarcity of applications related to table tennis techniques and tactics. Based on the existing research and knowledge in relevant fields, the article examines the application of video technology and data mining technology in table tennis matches within the context of wireless sensor networks. The following conclusions are drawn: 1. Video technology and moving object detection technology can be effectively applied to the analysis and statistics of table tennis games. This lays the groundwork for further algorithm research in this area; 2. Wireless sensor networks, or the Internet of Things (IoT), possess characteristics such as efficient data processing and dynamic data analysis. These attributes enable timely data processing in the context of rapidly changing table tennis matches; 3. By utilizing data mining technology in simulations, it is observed that underspin, swing, and arc combinations are frequently employed in table tennis matches. This insight suggests that players should exercise caution when facing opponents who utilize such techniques; 4. Although the proposed scheme in the article significantly enhances the utilization of data pertaining to table tennis matches, its implementation process is somewhat complex. Future research should focus on improving the data processing speed and enhancing the real-time analysis and mining capabilities for match data.

Overall, the article underscores the potential of video technology, data mining, and wireless sensor networks in advancing the analysis and understanding of table tennis matches. The conclusions drawn serve as a basis for further research and development in this domain, with an emphasis on streamlining the implementation process and enhancing real-time analysis capabilities.

In conclusion, advancement of innovation of technology in table tennis have been seen continuously in order to enhance the player's experience in the forms of individual equipment for playing such as table tennis racket, table tennis rubber, equipment for skill promotion such as ball feeding machine, and equipment for technical analysis. It can be summarized that all the innovation and technology created in any kinds of sports will help heighten the player's skills, improve any player's weaknesses, evaluate the player's performance and collect the data of the game for coaches. Most importantly, for the player's ability or competency development the innovation and technology must be created most similarly to the real competition situation and improved gradually for modernization.

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