

Creating a User-Controllable Pickleball Serving Machine

(Technical Topic)

A Study on the Health Effects of Pickleball's Increasing Popularity on the Elderly

Community

(STS Topic)

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

As health medicine improves throughout the world, the population of seniors increases because they are able to stay healthy for much longer. In a 2020 study, 1 in 6 Americans were 65 years or older, totaling 16.8% of the US population (US Census Bureau, 2023). One of the key elements in maintaining proper health as a senior is physical activity, and many seniors have turned to pickleball to satisfy this need. From 2019 to 2022, pickleball was the fastest growing sport in the United States, seeing a 159% increase in players (Mackie, 2023). This is in part because of the circumstances regarding the COVID-19 pandemic, as pickleball introduced a new way to be social without needing to be too close to partners or opponents. In addition to this perk, pickleball also offers a slower paced playing experience which makes it able to be played by a wider range of people, since it does not require as much athleticism or skill as similar sports like tennis or racquetball. As a result, many elderly people have taken up the sport, which means that they are getting out and exercising during their leisure time.

With the growing pickleball community comes a need for additional infrastructure, too. While one full tennis court can be converted into two pickleball courts, the estimated financial demand to satisfy the growing pickleball craze will total about \$900 million nationwide (*Report: Building More Pickleball Courts Needs to Be a Priority*, 2023). The massive uptick of users and the strong demand for more courts demonstrate that pickleball will likely be here to stay, so it is important to study the circumstances that brought it into the spotlight as well as the effects on those influenced.

Technical Topic: Creating a User-Controllable Pickleball Serving Machine

For my technical topic, I will be working with my classmates Clara Li and Sharon Lu on designing a pickleball serving machine. As pickleball is growing so quickly, we aim to bring an

affordable serving machine to the public, as many of the ones available cost upwards of \$1000 (Pickleball Machines, 2023). Pickleball has been the fastest growing sport in the U.S. for the past few years. While the sport has historically catered to older demographics, this has begun to shift. A study conducted in August 2022 by the Association of Pickleball Professionals (APP) found the average age of avid pickleball players to be 34.8 (Webb, 2023). Our team is capitalizing on pickleball's growing popularity among all demographics by creating a pickleball machine that trains the user by shooting pickleballs from across the court at varying speeds and angles. This training companion serves to help the user improve their pickleball skills, hand-eye coordination, agility, and overall cardiovascular fitness.

Being able to practice rallies independently is difficult, and many pickleball training machines are expensive. Popular, highly rated pickleball machines such as the Erne and Pickleball Tutor Plus retail for \$1799 and \$1199, respectively. This steep price tag comes with many useful features, though. The machines can serve a variety of pickleball strokes including serves, groundstrokes, dinks, lobs, and drives. They also have different timing configurations and shot location customizations (*Shop | Victory Sports Techn*, 2016) (*Pickleball Tutor - Sports Tutor Company*, 2023). Similar projects have been done in the past to provide cheaper alternatives. These launchers share the dual motor launching mechanism but fall short on certain features. For instance, some launchers do not have vertical and horizontal angle adjustments or ball reservoirs (Obo0, 2013). Those that do have a limited user interface or require manual adjustments (RichVideosNH, 2018). The primary goal of this project is to make solo training more accessible by offering users a training machine with more shot options at a lower price tag. To increase the range of pickleball shots, our machine will be adjustable from a horizontal angle using a motor and the up-down angle using a linear actuator. Two motors will spin concurrently to eject

pickleballs, and the varying speed of the two motors will allow for different types of shots such as topspin and backspin. Furthermore, our machine will have a user interface with dials so that users can control the trajectory more precisely.

For our pickleball machine to deliver on its training features, our team will have to ensure that the mechanical components of the project integrate seamlessly with the embedded and electrical components. Knowledge of kinematics from Physics I for Engineers will be integral in calculating the specifications for the motors needed and the angles they should be mounted. Background from Introduction to Embedded Computer Systems will enable us to interface with the hardware components and program our desired shot configurations. Finally, what we have learned from the Electrical and Computer Engineering Fundamentals series will be useful in designing the PCB that will power our various motors and linear actuators.

Science, Technology, and Society (STS) Topic: A Study on the Health Effects of Pickleball's Increasing Popularity on the Elderly Community

As people grow older, it becomes more difficult to maintain muscle structure and general mobility. However, by incorporating at least 75 minutes per week of vigorous activity such as running or jogging (CDC 2023), seniors can see effects like maintaining muscle strength and balance as well as delaying many of the other physical problems that come with aging (Chou et al., 2012). These activities are recommended to split over at least two days in a week. In this study, I aim to determine whether the increase in pickleball's popularity and its corresponding infrastructure have a correlation with increased physical and mental health in the senior community. Pickleball presents a perfect example of an activity that covers these criteria, as it involves running, agility, and hand eye coordination. A game of pickleball will usually last about

15-25 minutes (Fairey, 2022), so three or four games a week is enough to delay health complications that arise in senior years. However, as the COVID-19 Pandemic changed the way that the world viewed things like exercise and social interaction, it became challenging to get out and get the right amount of exercise. This was especially true for seniors, as they are at higher risk of COVID-19 related complications. As stated earlier, though, pickleball is a COVID-19 friendly option for exercise, and as such, it became very popular.

In order to fully understand how technology and society have interacted to enable pickleball's fast growth, I will use the Social Construction of Technology (SCOT) framework. This framework views technological innovation as something driven largely by societal influence. The main focal point of SCOT I will be analyzing will be the relevant social groups involved in the growth in pickleball's popularity. In looking at this phenomenon, a couple of social groups seem especially relevant. These groups are seniors who play pickleball, those who don't and are affected by it, the construction industry that builds tennis and pickleball courts, and pickleball equipment manufacturers. While there are certainly other groups that interact with these four, these are the ones that will be most relevant to the study. In terms of cause and effect, the primary cause associated with this phenomenon is COVID-19's outbreak, and there is a chain of causality between the pandemic, the increase in pickleball, and the increase in physical and mental health of those seniors who play pickleball (*An Examination of Pickleball Participation, Social Connections, and Psychological Well-Being among Seniors during the COVID-19 Pandemic*, 2021). The group of bystanders are those who take annoyance to the sport, namely tennis players whose courts may get repurposed, and homeowners nearby to courts. Homeowners tend to dislike the sport, as the paddles have a more percussive noise when hitting balls, and the players are often louder in games than in other sports because of the social nature of the sport

(Meyersohn, 2023). Although it was invented in 1965, the desire for safe social and athletic activities took a heavy role in bringing this sport to popularity, and as a result, bringing in the need for more court space to be built, which makes SCOT a good STS framework to use during the study.

In order to study this phenomenon, I will compile a list of scholarly articles and experiments centered around the overall health of seniors who play pickleball, namely those who started during the recent uptick in the community. Ideally, I will be able to pinpoint how pickleball has replaced or supplemented parts of these people's exercise routines. With this information, I will look at the cause of this and the effect it elicits in both their physical well being and mental health. Most of this information will likely be gathered on Google Scholar, with other sources from the UVA library to supplement these articles. The key question I want to investigate is the degree to which pickleball impacts these aspects of health and quality of life. As stated above, I believe it will also be important to look at the effect on other people, since if it has a profound negative effect on some people then pickleball's popularity becomes a more nuanced issue. It will be beneficial to note the impact on the relevant industries, but this won't be a core concept to study.

Conclusion

By studying how the rise in pickleball's popularity affects the relevant social groups listed, I will be able to gain a better understanding of how science, technology, and society interact. Specifically, this study has potential to influence a further increase in senior health, given that pickleball has the positive impact that I am looking to prove. By raising more awareness about this up and coming sport and influencing more people to get active and get social, seniors affected can improve their general quality of life. Conversely, if this study proves

the opposite, it will also be useful in advising seniors against activity like pickleball and maybe pushing towards less strenuous activity like leisurely walks. In terms of the SCOT framework, if this phenomenon can be effectively understood using SCOT, it could then be applied to similar things going on in our country and other countries.

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