Interactive Machine Learning based on Player Behaviors for Better User Experiences: A Preliminary Pilot Study on the Social Playability of the Nintendo Switch During the COVID-19 Pandemic

Liu JinKua, Dr. Ya Tang
Department of Computer Science, Wenzhou-Kean University, jinkual@kean.edu

Introduction

Due to COVID-19 pandemic, most of people were forced to keep distance to each other for a relatively long time, so a wide variety of online games rush to their living rooms so as to help people engage in social interacts (Ibbetson, 2021), maintain mind well-being and decrease pressure (Kleinman,2021). Those said, Nintendo Switch, is one of the most popular game consoles in China. According to Bloomberg news, until Dec 2020, Switch has sold nearly 4 million units which is much higher than other game consoles in China market. (Bloomberg, 2020) Moreover, as more and more Chinese people changes their attitudes to the motion-based games aiming at exercise, social interaction, entertainment, the future market in China for Switch is profitable (Yuqi,2020). However, Switch still has some usability problems which motivates us to study the user experience of Switch, particularly with regard to its social playability (Sánchez,2009) during the pandemic. In the longer run, player behaviors, particularly in a social context, can be tracked and modeled to allow continuous improvement of the game.

Methods and Materials

This research applies both quantitative and qualitative method to study the usability and the social playability of Nintendo Switch during the COVID-19 pandemic.
Literature Review of 14 articles which related to usability test, game user experience analysis, player emotion analysis and so on has done in order to provide a research direction of the study. There are three phases for the research:
1. Pilot questionnaire: to assess the user experience of Switch Joy-Con. This online survey was published through QR code to who has the Nintendo Switch in order to study the general user satisfaction of Switch.
2. Objective analysis:
   a. To analysis the design and arrangement of Joy-Con base on NASA HCI handbook and Switch with PS4 aiming at finding the usability problems of Switch based on current handbook.
   b. Study the player behaviors through machine learning. In this step, researcher collected the user's data through the sensor (Electromyography and Heart Rate) in order to study the emotion of the player during the play target in study the user experience and the benefit of playing video games during the COVID-19 quarantine.
3. Subjective analysis:
   a. To analysis subjective user experience in pilot lab testing.
   b. Conduct the playability of Nintendo Switch Joy-Con in the social context.
   In this part of study, 2 questionnaires were delivered to the participate. The first one is aiming at study the subjective satisfaction of the Switch. The second questionnaire was expected to study how participates using video game during the COVID-19 quarantine.

Results

Pilot Analysis:

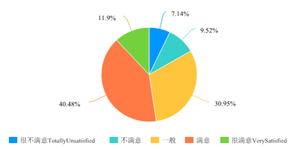

Figure 1: The general satisfaction of Switch

Objective Analysis (a):

Joy-Con										
	Diameter+	Pass/Not	Displacement	Pass/Not	Separation+	Pass/Not	Height			
XYBA	7.17mm	X	0.82mm	X	6.90-6.14mm	X	1.61mm			
Home	7.91mm	X	0.1mm	X	8.97/3.07mm	X	0.41mm			
UpDownRightButtons	7.89mm	X	0.95mm	X	8.96/4.63mm	X	0.45mm			
	Width	Pass/Not	Length	Pass/Not	Separation1	Pass/Not	Separation2	Pass/Not	Displacement	Pass/Not
R&L	23.20mm	✓	10.43mm	✓	78.78mm	✓	14.67mm	✓	0.84mm	X
ZR&ZL	22.60mm	✓	9.98mm	✓	77.05mm	✓	14.67mm	✓	+2.030mm	X
	Diameter	Pass/Not	Length	Pass/Not	Separation1	Pass/Not	Separation2	Pass/Not	Displacement1	Pass/Not
Joy-Stick	14.69mm	✓	8.66mm	X	105mm	✓	80mm	✓	0.6mm	X
	Width	Pass/Not	Length	Pass/Not	Separation	Pass/Not			Displacement	
PrintScreen	8.14mm		5.34mm		0.85mm	X			0.85mm	X

DualShock 4										
	Diameter+	Pass/Not	Displacement	Pass/Not	Separation+	Pass/Not			Height	
XOCT▲	10.25mm	X	1.29mm	X	13.7&6.08mm	X/X			1.66mm	
Home	7.95mm	X	0.76mm	X					0.76mm	
	Width	Pass/Not	Length	Pass/Not	Separation+	Pass/Not	Displacement+	Pass/Not	Height	
UpDownRightButtons	8.2mm		10.63mm		4.26mm	X	0.76mm	X	0~3.17mm	
	Width	Pass/Not	Length	Pass/Not	Separation	Pass/Not	Displacement	Pass/Not	Height	
R1&L1	19.69mm		10.43mm		78.78mm	✓	2.27mm	✓	2.02mm	
R2&L2	14.69mm		16.98mm		78.17mm	✓	<0.69mm	✓		
	Diameter	Pass/Not	Length	Pass/Not	Separation	Pass/Not	Displacement1	Pass/Not	Displacement2	Pass/Not
Joy-Stick	18.06mm	X	7.92mm	X	49.03mm	✓	0.7mm	X	20°	✓
	Width	Pass/Not	Length	Pass/Not	Separation	Pass/Not	Displacement	Pass/Not		
Share&Option	8.45mm		8.92mm	X	50.90mm	✓	0.3mm	X		

Table 1: The objective assessment of PS4&Switch Controller

From the data, researcher conclude those result.
1. The buttons (XYBA, UDRL, joy-stick, - +) need to enlarge the diameter, the height and decrease the resistance. Moreover, these buttons may need new arrangement of place.
2. ZR&ZL may need to enlarge the size of the button.
3. The handle of the Joy-Con also need to be enlarged which could be easily held by user.
4. The handle area which contact with the thumb and little finger may need enlarge in order to support these two fingers.

Figure2: the contact area of player's hand with the Switch Controller

Objective Analysis (b):

Figure3&4: The player1's heart rate data of 30s average and its 5 periods mean bar plot with error (in 60 mins)

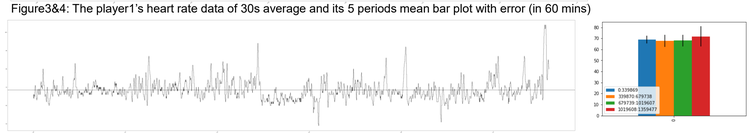

Figure4&5: The player2's heart rate data of 30s average and its 5 periods mean bar plot with error (in 40 mins)

Subjective Analysis(a):

	Dual Shock	Joy-con Grip	Joy-Con portable
The shape of controller			
The comfort level of the width of the controller	4.5	3.6	3.7
The comfort level of the length of the controller	4.4	4.3	4.3
The comfort level of the height of the controller	4.2	4.2	3.9

Table2: One of the result table conclude in Subjective Analysis

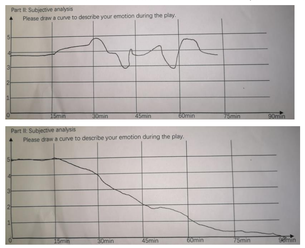

Figure 6&7: The Subjective Analysis of player's emotion during the play

Subjective Analysis(b):

Researcher has concluded some findings from the questionnaire of how video games has been used during the COVID-19 pandemic in China. Different from Krica(2021)'s findings, people rarely use video game to hold any special ceremony or a substitution of daily event since they regard it as a way to killing time in China. Moreover, video games may not establish roommate relationship during the quarantine, people prefer to play with closed one in the room rather than a stranger even they are locked down in the same room. All of participate mention that they had a pleasure time with closed one but 2/3 people mention that they would prefer to play online video game if they locked up with a stranger. However, video still work as a way to maintain people's mental health since all participates mentioned that playing video game makes them joyful.

Conclusions

From the study above, researcher find that the video game is vital importance for people during the COVID-19 quarantine. Based on the objective and subjective analysis during the play and the questionnaire of how video game has been used during the quarantine , researcher has found that video games could influence player' emotion and social relationship with others. Nintendo Switch is one of the most popular console in China still has some usability problems. According to the analysis in the research, the usability of Nintendo Switch still need to improve.
However, this is only a pilot study. This research is still at a primary stage and some part of research still need to be polished. For example, the lab experiment may need more participates and the questionnaire in the research is too rough which may cause misunderstanding. Moreover, the data analysis is still at a really primary step. The data could not give some strong evidences to support the advice and idea. With enough support the research could go more deeper and may give a prototype of idea controller for Joy-Con.

References

Refrences
Alan J. Fridland, John T. Cacioppo. (1986). Guidelines for Human Electromyographic Research. Psychophysiology.
Anders Drachen, Lennart E. Nacke, Georgios Yannakakis, Anja Lee Pedersen. (2010 年 July 月). Correlation between Heart Rate, Electrodermal Activity and Player. Retrieved from: ACM: https://dl.acm.org/doi/10.1145/1836135.1836143
Bhardwaj, R. (2017). The Ergonomic Development of Video Game Controllers. *Journal of Ergonomics*, 7,209. doi:10.4172/2165-7556.1000209
Brooke, J. (1995, 11). *SUS: A quick and dirty usability scale*. Retrieved from Research Gate: https://www.researchgate.net/publication/228593520_SUS_A_quick_and_dirty_usability_scale?enrichId=rgreq-e90ac568adec13855d15e81cc484d8d0-XXX&enrichSource=Y292ZXJQYWdlOzIyODUzMzUyMDtBU1o5MTkzODIwNTQxNjI0MzNAMTI5NjkxOTE3MTcxMQ%3D%3D&el=1_x_2&_esc=publicationCoverPdf
Erica Kleinman, Sara Chojnacki, Magy Seif El-Nasr. (2021, January). *The Gang's All Here: How People Used Games to cope with*. Retrieved from ResearchGate: https://www.researchgate.net/profile/Erica-Kleinman-2/publication/348663337_The_Gang%27s_All_Here_How_People_Used_Games_to_cope_with_COVID19_Quarantine/links/6009f0a7299bf140888c18fc/The-Gangs-All-Here-How-People-Used-Games-to-cope-with-COVID19-Quarantine.pdf
Gabriel Isaac L. Ramolete, Julia Isabel F. Almirante, Junelizа M. Mondragon, Cyrus Alexander R. Ting, Michael Angelo Patrick C. Cohen, and Benette P. Custodio. (2020). Physical Design Assessment of the Nintendo Switch Controller Configurations. In M. S. Francisco Rebelo, *Advances in Ergonomics in Design 2020* (pp. 198-205). Springer. Retrieved from https://doi.org/10.1007/978-3-030-51038-1_29
Haiying Wang, Lu Liu. (2020 年 Mar 月 15 日). Experimental investigation about effect of emotion state on people ' s. Retrieved from ScienceDirect: https://www.sciencedirect.com/science/article/pii/S0378778819324347?via%3Dihub
Iman Danat, , Moein Nedaei, Mohammad Ali Mostashar Nezami. (2015). The effects of tool handle shape on hand performance, usability and discomfort using masons' trowels. *International Journal of Industrial Ergonomics*, 13-20.
Ibbetson, R. (2021)Building blocks for the future: Lego unveils global expansion plans on back of a £1.1billion profit after surge in popularity with adults and children passing the time during lockdowns. DailyMaill.com, March, 10, 2021. Accessed on March 11, 2021
J.L. González Sánchez, N. Padilla Zea, and F.L. Gutiérrez. (2009). *Playability: How to Identify the Player Experience in a Video Game* . Retrieved from SpringerLink: https://link.springer.com/content/pdf/10.1007%2F978-3-642-03655-2_39.pdf
Lukis, J. M. (2020, 7 26). *Nintendo Switch: Target Marketing and (Demographics & Psychographics)*. Retrieved from Medium: https://jasonmattlukis.medium.com/nintendo-switch-target-marketing-and-demographics-psychographics-fd994ad5f843#:~:text=What%20exactly%20was%20the%20target,X%20and%20Generation%20Y%2FMillennials.
Maarten B Jalink medical doctor , Erik Heineman professor, paediatric surgeon, , Jean-Pierre E NPierie professor, general surgeon, Henk O ten Cate Hoedemaker abdominal surgeon. (2014, 12). Nintendo related injuries and other problems: review. *BMJ*. doi: 10.1136/bmj.g7267
NASA. (2014). 10.4 Control. In NASA, *HUMAN INTEGRATION DESIGN HANDBOOK (HIDH)* (pp. 968-1019). Washington, DC, USA: NASA.
Nazlena Mohamad Ali, Siti Zahidah Abdullah, Juhana Salim, Riza Sulaiman. (2012 年 Decemnber 月). Exploring User Experience in Game Using Heart Rate Device. 新照化: ResearchGate: https://www.researchgate.net/publication/236336136_Exploring_User_Experience_in_Game_Using_Heart_Rate_Device
Yuqi Liu ,Yao Song , andRyoichi Tamura. (2020). *Hedonic and Utilitarian Motivations of Home Motion-Sensing Game Play Behavior in China: An Empirical Study*. Retrieved from MDPI: https://www.mdpi.com/1660-4601/17/23/8794
Zheping Huang, Takashi Mochizuki. (2020, 12 10). *China Is Nintendo's Secret Weapon in War With PlayStation, Xbox*. Retrieved from Bloomberg: https://www.bloomberg.com/news/articles/2020-12-09/china-is-nintendo-s-secret-weapon-in-war-with-playstation-xbox