XIAMEN UNIVERSITY MALAYSIA
厦門大學馬來西亞分校

School of Computing and Data Science (SCDS)
Reference No. : XMUM.SCDS (V4)
Effective Date : 15 Sept 2023

Undergraduate FYP Proposal Form[1]

Section I: Student's Information:			
Full Name	Tan Jie Ying		
Student ID	DSC2009997	**Mobile**	+6017-2156218
Email ID	dsc2209997@xmu.edu.my	**Programme**	DSC

Section II : Industry Information: (Complete this section if your project is going to be conducted in partnership with any company)			
Company Name			
Contact Person			
Designation		**Phone**	
Email ID			

Section III : Declaration by the Student

By signing this form, I confirm that I have read and will adhere to the **Final Year Project Proposal Guidelines** of Xiamen University Malaysia as applicable to this application.

Signature of Student: Jwei

Date: 10/6/2025

Section VI : Supervisor Approval			
Name of Supervisor	Dr. Toa Chean Khim		
Office Location	A1-361		
Email Address	cheankhim.toa@xmu.edu.my		
Office Extension	-		
Signature		**Date**	13/6/2025

[1] The length of the proposal should be between 2000-3000 (Excluding proposed title & references)

SECTION V : Proposal Information	
Proposed Title *(Not more than 20 words)*	Fatigue-Related Biomechanical Changes in Pickleball Players Using Sit-to-Stand (STS) Movement and Pose Estimation
Introduction/Problem Statement *(300-500 words)*	1.0 Problem Statement Fatigue is a widely recognized factor negatively influencing athletic performance, particularly in dynamic, fast-paced sports such as pickleball. It often results in significant biomechanical changes including reduced range of motion, slower reaction times, unstable postures, diminished coordination, and incomplete movements. These subtle yet impactful alterations in movement quality are difficult to detect through casual observation alone, particularly in recreational settings where professional monitoring tools are rarely accessible. In pickleball, non-professional players commonly lack objective and accessible methods to accurately measure and evaluate how fatigue accumulates and influences their physical performance over varying play durations. Most players rely primarily on subjective perceptions or generalized assumptions about their fatigue and stamina levels, which may lead to inaccurate assessments of their actual physical state. Without clear, measurable data, players might unknowingly continue training or competing beyond their optimal performance window, potentially increasing the risks of injury, performance deterioration, and inefficient training outcomes. Currently, existing fatigue detection methods in professional sports and clinical environments typically involve sophisticated and expensive equipment such as force plates, electromyography sensors, or advanced motion capture systems. These methods, although effective, are often impractical for non-professional athletes due to their cost, complexity, and limited accessibility. Therefore, there is a critical need for simpler, affordable, and easy-to-use techniques capable of objectively quantifying fatigue and stamina for everyday non-professional players. This research aims to directly address this gap by clearly examining the feasibility of utilizing the Sit-to-Stand (STS) movement as a practical, repeatable, and reliable indicator of fatigue and stamina in pickleball players. STS is widely recognized in

	biomechanics and sports science literature as an effective method for detecting lower-body fatigue, given its simplicity, high repeatability, and sensitivity to fatigue-induced changes in joint angles, stability, and movement timing. Eventually, the outcomes of this research will enable non-professional pickleball players to clearly identify their optimal playing durations and fatigue thresholds and empower them to make better-informed decisions regarding training schedules and performance management. This will not only help improve their gameplay effectiveness but also significantly reduce potential risks associated with fatigue-induced injuries and poor performance outcomes.
Aims and Objectives ***(100-200 words)***	2.0 Aims By clearly employing accessible video-based pose estimation technology, this project aims to objectively analyze and compare biomechanical patterns of players performing the STS task before and after pickleball sessions of different durations (15, 30, and 60 minutes). This approach provides clear, quantifiable insights into how fatigue progresses and impacts player performance across varied durations of physical activity. Eventually, the project seeks to enable better-informed training decisions and injury risk reduction by providing players with actionable feedback on their fatigue state. 2.1 Objectives 1. To review and develop the Sit-to-Stand (STS) movement protocol as a practical fatigue assessment tool for non-professional pickleball athletes, and to collect video data of STS performance before and after play sessions of varying durations. 2. To extract joint angles and biomechanical features from pose estimation, and to model and analyze fatigue-related changes in these features using appropriate statistical techniques (e.g., comparative analysis of pre- and post-play data). 3. To develop a rule-based analysis system that detects and communicates fatigue-related biomechanical changes and providing clear visual and textual feedback to players regarding their fatigue status.
Background Study/ Literature Review ***(1000-1300 words)***	3.1 Understanding Pickleball Pickleball is a paddle sport that combines elements of tennis, badminton, and table tennis. Played on a court similar in size to a

	double's badminton court, it utilizes a perforated plastic ball and solid paddles. The game can be played in singles or doubles formats, both indoors and outdoors which make it accessible to a wide range of players (USA Pickleball, 2020). Despite its approachable nature, pickleball is physically demanding. The game involves quick lateral movements, rapid directional changes, and sustained rallies, which can lead to significant physical exertion. These repetitive and high-intensity movements engage multiple muscle groups, including the core, legs, and upper body, contributing to muscle fatigue over time (Sizemore, 2020). Moreover, the sport's stop-and-start dynamics, combined with the need for quick reflexes and continuous engagement, can lead to both acute and chronic fatigue. Players often experience muscle soreness and decreased performance levels after extended play sessions, indicating the sport's capacity to induce fatigue (Flamm, 2024). Non-professional players, who may not have structured training or recovery protocols, are particularly susceptible to fatigue-related performance declines. Without proper monitoring and recovery strategies, these players risk overexertion, which can lead to decreased enjoyment, performance plateaus, or even injury (Flamm, 2024). 3.2 Fatigue and Athletic Performance in Pickleball Fatigue is a multifaceted phenomenon that significantly impairs athletic performance by inducing both physiological and biomechanical changes. In dynamic sports like pickleball, which demand agility, quick reflexes, and precise movements, even moderate fatigue can degrade performance (PB Vision, 2016). Studies have shown that as muscles tire, athletes exhibit subtle but impactful biomechanical alterations such as reduced joint range of motion, slower neuromuscular response times, impaired coordination, and less stable posture (Yang et al., 2019). For example, an article observed that repetitive tasks leading to muscle fatigue caused changes in motor coordination and movement stability, along with increased variability in joint kinematics as fatigue progressed (Gates & Dingwell, 2011). Similarly, Yang *et al.* reported that fatigue alters joint angles and inter-joint coordination, affecting overall movement pattern. These changes can manifest in pickleball players as slower reaction times, shakier balance when reaching or changing direction, and incomplete movements such as not fully extending the legs during strokes or landings, all of which compromise skill execution (Yang et al., 2019).

Not only does fatigue degrade performance, it also elevates injury risk. Proper mechanics and fluid movement patterns are known to enhance performance and reduce injuries in pickleball (PB Vision, 2016). When fatigue sets in, those mechanics break down and knees may not bend or extend as fully, then players might lose postural control and cause them to strains or falls. Indeed, research links muscle fatigue with decreased force output and peak power, which impairs functional performance and may contribute to acute injury risk as tired muscles fail to stabilize joints (Zhao et al., 2023). These findings highlight why *early detection of fatigue* is crucial by recognizing the subtle signs of fatigue-induced movement degradation, players and coaches can intervene (rest or adjust training) before performance drops too far or injuries occur.

3.3 Challenges in Detecting Fatigue for Non-professional Athletes

Despite the clear impact of fatigue, casual observation is often insufficient to catch early fatigue signs in recreational settings. Minor reductions in knee or hip range of motion, slight delays in reaction, or mild postural wobbles can be easily overlooked without instruments. Fatigue-induced movement changes are typically subtle and cumulative, making them hard to differentiate by eye until performance has already significantly become worse. Non-professional pickleball players, who usually lack access to on-site trainers or high-tech monitoring and they must often rely on subjective judgment – *"Do I feel tired?"* – to measure fatigue. However, the perception of fatigue is highly subjective, influenced by motivation and psychological factors (Roldán Jiménez et al., 2019). Athletes frequently misjudge their level of fatigue, either underestimating it or pushing through it, which can lead them to continue playing beyond their optimal performance window. This reliance on subjective fatigue measures (like feeling "out of breath" or muscle soreness) is prone to error. Studies in sports science note that self-perceived fatigue does not always align with objective performance declines (Roldán Jiménez et al., 2019). In practice, a pickleball player might *feel* capable of playing on, yet their movement quality (speed, balance, form) may be significantly reduced unbeknownst to them.

The lack of accessible, objective fatigue monitoring tools for everyday athletes represents a critical gap. High-performance sports and clinical biomechanics labs have long used sophisticated equipment to quantify fatigue and its effects. For example, force plates to detect changes in ground-reaction forces during jumps or hops, electromyography (EMG) to measure muscle activation frequency shifts, and 3D motion capture systems to precisely track joint kinematics. These methods are effective but expensive and impractical for routine use by non-professionals (Erfianto et al., 2024). Force platforms and marker-based motion capture rigs cost tens of thousands of dollars and require expert setup; EMG devices, while more portable still involve electrodes and technical expertise. As a result, non-professional players rarely have data-driven insight into their fatigue levels. They often do not realize their form has degraded until obvious signs (like drastic play errors or extreme exhaustion) appear. This gap between available advanced fatigue diagnostics and their real-world accessibility motivates the search for simpler solutions that can bring objective fatigue assessment to the average pickleball court.

3.4 Sit-to-Stand (STS) Test as a Fatigue Indicator

In sports science and rehabilitation, the Sit-to-Stand (STS) movement is widely recognized as a practical test of lower-body function. The STS task is rising from a chair to a full stand that engages major muscle groups in the legs and core, and is often used to assess strength, balance, and functional mobility (especially in older adults) (Erfianto et al., 2024). Beyond general fitness, researchers have identified STS performance as a sensitive indicator of lower-limb fatigue. For instance, poor or incoordinated STS execution correlates with reduced physical health and independence in clinical populations (Erfianto et al., 2024). In an athletic context, the STS movement's simplicity and repeatability make it ideal for tracking fatigue-induced changes, as fatigue increases, athletes may perform STS with slower speed, altered joint angles, or unstable balance. Roldán Jiménez *et al.* note that recent studies of the 30-second STS test (repeated chair rises) have moved beyond simply counting repetitions to analyzing kinematic and muscular variables to quantify fatigue. For example, instead of only recording how many STS repetitions a person can do, researchers measure how the movement quality degrades over time, for example, whether the peak knee/hip extension angle decreases as the legs tire, or if the standing up phase takes longer with each repetition.

Using STS as a fatigue proxy is appealing because it is both practical and sensitive to fatigue's effects. Unlike a full game of pickleball, an STS trial is quick and can be done in a controlled manner before and after exercise. Prior research has demonstrated that muscle fatigue accumulated from various activities (running,

	resistance exercise, etc.) can be detected by changes in STS mechanics. Notably, coordination variability in STS tends to increase with fatigue, reflecting the body's struggle to maintain the same movement pattern as when fresh (Gates & Dingwell, 2011). Also, joint angle ranges may diminish, for example, a fatigued player might not straighten their knees fully when rising due to quadriceps tiredness. By capturing such metrics, the STS test can effectively serve as a replacement measure of a player's fatigue level at a given time. 3.5 Pose Estimation Technology for Biomechanical Analysis To leverage the STS movement as a fatigue estimation in an accessible way, this research turns to modern computer vision, specifically, video-based human pose estimation. Human pose estimation (HPE) is a technology that automatically detects and tracks key body joint positions from images or video (PB Vision, 2016). With advancements in machine learning, markerless pose estimation algorithms such as OpenPose, AlphaPose, and Google's MediaPipe can extract joint angles and movement patterns using just a standard camera feed (Erfianto et al., 2024). This offers a compelling alternative to lab-based motion capture which no wearable sensors or markers are needed, also drastically reducing cost and setup complexity (Erfianto et al., 2024). Indeed, pose estimation has already seen growing applications in sports including pickleball to analyze athletes' techniques and identify injury risk factors (PB Vision, 2016). By applying HPE to video of a player performing STS, we can obtain quantitative biomechanical data such as knee, hip, ankle angles over time without specialized hardware. MediaPipe is a lightweight, real-time pose estimation framework well-suited for this project's needs. It can run on ordinary smartphones or laptops, making it highly accessible. Prior studies have validated that pose estimation data can be used for fatigue analysis. For example, a study developed a system to detect fatigue during STS by using video-based pose tracking which is MediaPipe was employed to capture key joint coordinates, from which knee flexion/extension angles were computed throughout the STS motion (Erfianto et al., 2024). They then compared the angle-time curves from "fresh" vs "fatigued" trials using dynamic time warping to quantify differences (Erfianto et al., 2024). The study demonstrated that a simple camera and pose model could identify fatigue-induced deviations in the STS movement that offering proof-of-concept that vision-based systems can sense fatigue. Using such techniques, we

can extract features like peak joint angles, average standing speed, sway or balance metrics, and track how these change after different durations of play.

Pose estimation's advantages are clear, it is cost-effective and non-invasive, yet provides rich movement data (Erfianto et al., 2024). By avoiding cumbersome devices, it enables *in-situ* monitoring which is a pickleball player could be recorded performing STS on the sidelines with a phone camera, and the pose algorithm would output joint angles immediately. This makes objective fatigue assessment feasible in recreational environments where traditional equipment is impractical. Moreover, as a computer vision approach, it can potentially analyze multiple aspects of movement simultaneously (timing, symmetry, stability, etc.), giving a more complete picture of fatigue than any single metric device.

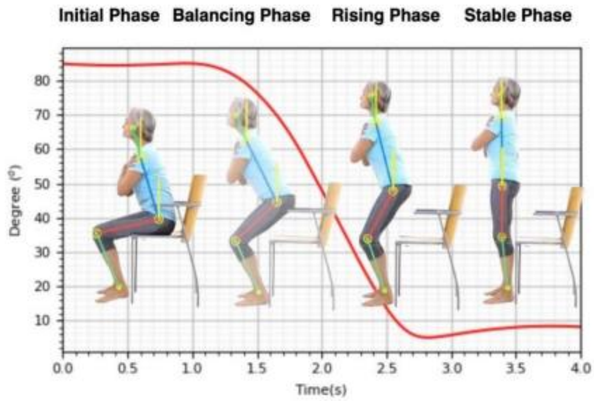


Figure 1 Knee Angle Flexion to Extension. (Erfianto et al., 2024)

3.6 Comparing "Fresh" and "Fatigued" States

A core component of this research is analyzing how biomechanical patterns differ between a player's fresh state and their fatigued state after playing pickleball for various durations. Exercise science literature indicates that fatigue accumulates progressively with continued activity, resulting in more pronounced impairments over time (Aquino et al., 2022). In other words, the longer one plays high-intensity sports, the more fatigue will set in and the more movement quality might degrade. By conducting controlled STS tests *before* play and *after* 15, 30, and 60-minute play sessions, we can observe how fatigue progresses across these intervals. We expect to see a gradient of changes: after a brief 15-minute session, a player might show only slight alterations in the STS metrics (perhaps a minor slow-down or a small loss of range), whereas after a full hour of play the fatigue effects should be much clearer such as significantly longer STS completion time, noticeable reduction in knee extension angle, or greater postural sway when standing up).

Research Methodology
(300-500 words)

4.0 Research Methodology

This study will adopt an experimental pre-post design to examine how fatigue affects the movement patterns of non-professional pickleball athletes, using Sit-to-Stand (STS) movements as a practical biomechanical fatigue indicator. The research will utilize accessible video-based pose estimation (MediaPipe) to extract joint angles and movement features, enabling an objective comparison between players' "fresh" and "fatigued" states after varied pickleball play durations.

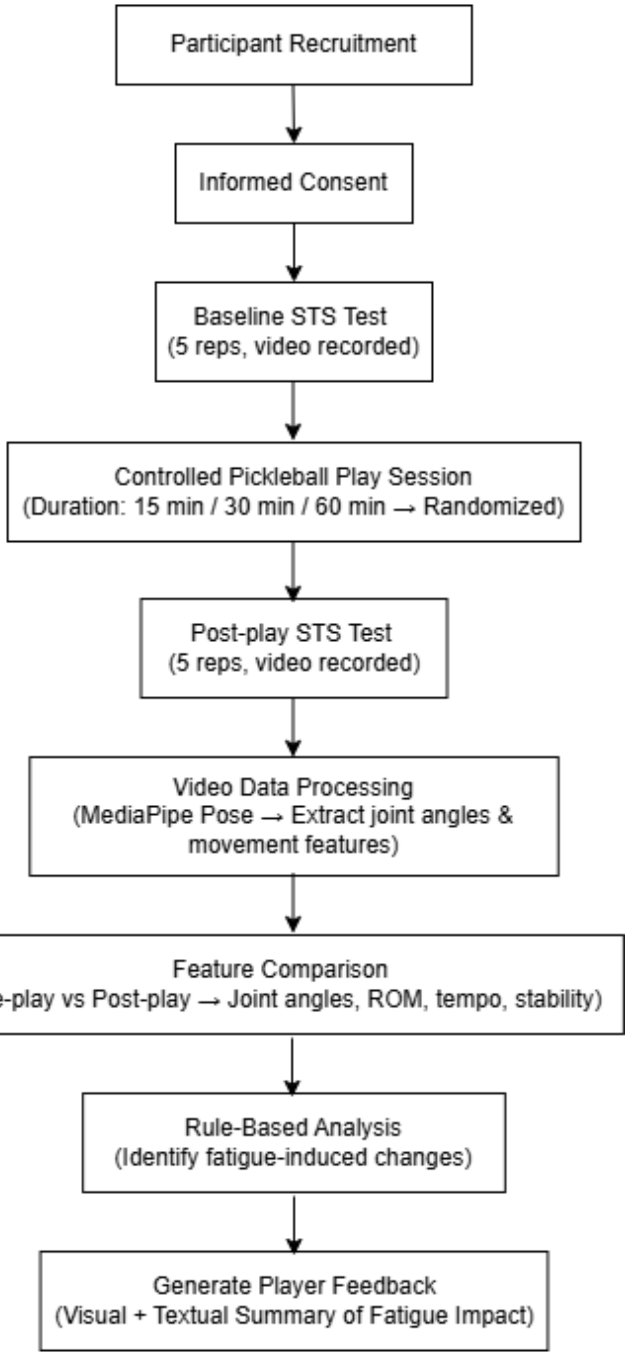


Figure 2 Flowchart of the experimental procedure for detecting fatigue-induced movement changes using Sit-to-Stand (STS) tests and MediaPipe pose estimation in non-professional pickleball athletes.

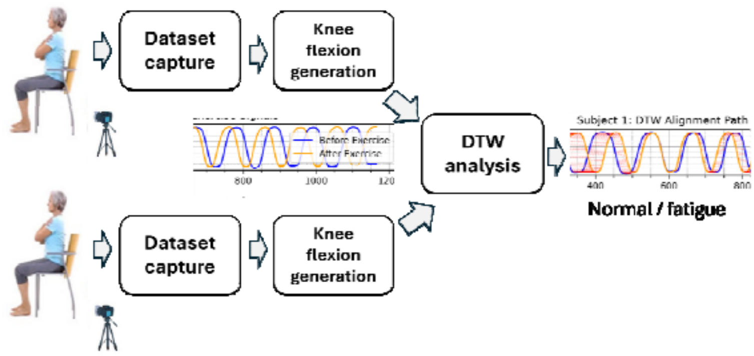


Figure 3 Proposed system for fatigue detection on STS. (Erfianto et al., 2024)

4.1 Participants

The study will recruit approximately 10 non-professional pickleball athletes (aged 18–40) from local sports clubs and community groups. Participants will have a minimum of 3 months of regular pickleball playing experience, ensuring that they possess consistent movement patterns and baseline fitness. All participants will be free of current lower-body injuries or neurological conditions that might affect mobility.

4.2 Experimental Protocol

Each participant will undergo the following experimental protocol conducted in a controlled indoor environment:

1. Baseline STS Test (Pre-play)
   Before any gameplay, participants will perform a standard 5-repetition Sit-to-Stand (STS) test from a standardized chair, recorded using a stationary video camera positioned at an optimal side view angle (capturing full-body sagittal plane motion).

2. Pickleball Play Session
   Participants will engage in controlled pickleball play sessions of 15, 30, or 60 minutes (randomized across trials). Play intensity will aim to replicate typical match-level activity, including rallies and varied movement demands.

3. Post-play STS Test
   Immediately following each play session, participants will repeat the 5-repetition STS test under identical recording conditions.

Each participant will complete all three duration conditions (on separate days) to enable within-subject comparisons of fatigue progression.

4.3 Data Collection and Processing

Recorded videos of the STS tests will be analyzed using MediaPipe Pose, an open-source, markerless pose estimation framework capable of extracting 33 body keypoints in real time (Lin et al., 2023). The following biomechanical features will be extracted:

- Joint angles: Hip, knee, and ankle angles throughout the STS cycle
- Range of motion (ROM): Peak extension and flexion angles per joint
- STS tempo: Time taken to complete each STS repetition and overall duration
- Postural stability: Lateral deviations, sway, and balance indicators

Figure 4 Mediapipe Pose's position detection of 33 posture joints. (Lin et al., 2023)

4.4 Fatigue Detection and Analysis

Extracted features from the Pre-play and Post-play STS tests will be compared using statistical and rule-based analyses:

- Changes in joint ROM, STS tempo, and stability will be computed for each participant across conditions.
- Fatigue-induced movement degradation will be identified based on deviations exceeding pre-defined thresholds (based on prior literature and pilot data).
- A rule-based feedback system will summarize findings, generating visual and textual reports to clearly communicate fatigue impacts to players.

	4.5 Ethical Considerations Participants will provide informed consent prior to participation. All data will be anonymized. The protocol will be approved by the relevant institutional ethics committee.
Potential Project Significance ***(100-200 words)***	5.0 Potential Project Significance This project offers a practical and accessible solution for objectively monitoring fatigue in non-professional pickleball athletes, addressing a critical gap in current sports performance tools. By utilizing Sit-to-Stand (STS) tests combined with video-based pose estimation (MediaPipe), the system enables the detection of subtle, fatigue-induced movement degradations that are often overlooked in recreational and amateur sports settings. The outcomes of this research can help players make better-informed decisions regarding training duration and recovery, ultimately improving performance consistency and reducing injury risks. Unlike traditional laboratory-based fatigue assessment methods, this approach is cost-effective, portable, and easy to implement which making it suitable for everyday sports environments. Moreover, the project demonstrates the broader potential of AI-driven, camera-based biomechanical analysis in enhancing sports safety and performance monitoring. The methodology developed here can be extended to other dynamic sports or adapted for home-based fitness applications and contributing to the growing field of personalized sports analytics. Eventually, this work empowers non-professional athletes with actionable insights, strengthen healthier, safer, and more effective participation in sport.
Expected Outcomes and/or Concluding Remarks ***(200-300 words)***	6.0 Expected Outcomes This project is expected to deliver an accessible and effective method for objectively assessing fatigue in non-professional pickleball athletes using Sit-to-Stand (STS) movements combined with video-based pose estimation. Through the collection and analysis of biomechanical data, the study aims to establish clear evidence of how fatigue progressively influences lower-body movement quality across varying play durations. By extracting features such as joint angles, range of motion, movement tempo, and postural stability, the project will identify consistent patterns of fatigue-induced changes, such as slower movement execution,

	reduced range of motion, and increased instability during STS performance. A key outcome of the project will be the development of a rule-based analysis system that can automatically detect and summarize these changes, providing players with clear visual and textual feedback on their fatigue state. This system will empower athletes to make better-informed decisions regarding training intensity, play duration, and recovery, helping to mitigate performance decline and reduce injury risk. In conclusion, this research will demonstrate the practical value of pose estimation-based analysis as a cost-effective alternative to traditional fatigue monitoring methods. The approach is highly portable and scalable which is suitable for use in everyday sports environments. Beyond pickleball, the methodology holds potential for broader application across various dynamic sports and fitness contexts, contributing to the advancement of personalized sports analytics and promoting safer, more sustainable participation in athletic activities.
Key References (10-20 references APA style)	Aquino, M., Petrizzo, J., Otto, R. M., & Wygand, J. (2022). The Impact of Fatigue on Performance and Biomechanical Variables—A Narrative Review with Prospective Methodology. *Biomechanics*, *2*(4), 513–524. https://doi.org/10.3390/biomechanics2040040 Erfianto, B., Rizal, A., Hadiyoso, S., & Istiqomah. (2024). Detecting fatigue in sit-to-stand transitions using knee flexion and dynamic time warping. *Journal of Physical Education and Sport ® (JPES)*, *24*(11), 2011–2021. https://doi.org/10.7752/jpes.2024.11299 Flamm, J. (2024, August 6). *Recover Like a Pro So You Can Play Pickleball For Life*. The Dink Pickleball. https://www.thedinkpickleball.com/recover-like-a-pro-so-you-can-play-pickleball-for-life/ Gates, D. H., & Dingwell, J. B. (2011). The effects of muscle fatigue and movement height on movement stability and variability. *Experimental Brain Research*, *209*(4), 525–536. https://doi.org/10.1007/s00221-011-2580-8 Lin, Y., Jiao, X., & Zhao, L. (2023). Detection of 3D Human Posture Based on Improved Mediapipe. *Journal of Computer and Communications*, *11*(2), 102–121.

https://doi.org/10.4236/jcc.2023.112008

PB Vision. (2016). *Pose Estimation Technology: Enhancing Safety and Performance in Pickleball - PB Vision*. Pb.vision. https://help.pb.vision/articles/9910344-pose-estimation-technology-enhancing-safety-and-performance-in-pickleball

Roldán Jiménez, C., Bennett, P., Ortiz García, A., & Cuesta Vargas, A. I. (2019). Fatigue Detection during Sit-To-Stand Test Based on Surface Electromyography and Acceleration: A Case Study. *Sensors*, *19*(19), 4202. https://doi.org/10.3390/s19194202

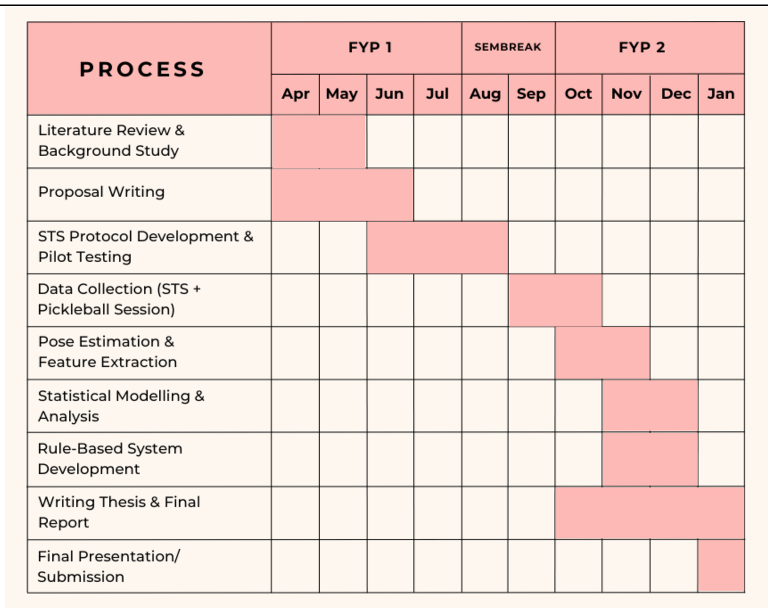
Sizemore, T. (2020, October 25). *What You Need to Know About Your Pickleball Recovery - Pickleball Hut*. Pickleball Hut. https://www.pickleballhut.com/what-you-need-to-know-about-your-pickleball-recovery/

USA Pickleball. (2020, July 21). *What is Pickleball? - USA Pickleball Association*. USA Pickleball Association. https://usapickleball.org/what-is-pickleball/

Yang, C., Leitkam, S., & Côté, J. N. (2019). Effects of different fatigue locations on upper body kinematics and inter-joint coordination in a repetitive pointing task. *PLOS ONE*, *14*(12), e0227247. https://doi.org/10.1371/journal.pone.0227247

Zhao, H., Seo, D., & Okada, J. (2023). Validity of using perceived exertion to assess muscle fatigue during back squat exercise. *BMC Sports Science, Medicine and Rehabilitation*, *15*(1). https://doi.org/10.1186/s13102-023-00620-8

Gantt Chart



APPENDIX 1

MARKING RUBRICS

Component Title	Proposal				**Percentage (%)**	**100**
Criteria	**Score and Descriptors**				**Weight (%)**	**Marks**
	Beginning (B)	**Developing (D)**	**Accomplished (A)**	**Exemplary (E)**		
i. Introduction *Identification of research problems, state clearly project objectives and scopes. (CLO4)*	0 ~ 2	3 ~ 5	6 ~ 8	9 ~ 10	**10%**	
ii. Aims and Objectives *Clearly distinguishable and achievable aims and objectives. (CLO4)*	0 ~ 2	3 ~ 5	6 ~ 8	9 ~ 10	**10%**	
iii. Literature Review *Provide a brief review of related works with adequate and suitable citations in APA style. (CLO2 & CLO4)*	0 ~ 4	5 ~ 10	11 ~ 16	17 ~ 20	**20%**	
iv. Research Methodology and/or Experiment Design *Identification, justification, and explanation of methodologies / models / techniques to be used for the project, Experiment design, appropriate use of software and tools, technical details. (CLO1 & CLO4)*	0 ~ 4	5 ~ 10	11 ~ 16	17 ~ 20	**20%**	
v. Results/Discussions/Rationale/ Timeliness *Project rational and timeliness, expected results or outcomes, with detailed plan for presentation, analysis and comparisons. (CLO1 & CLO4)*	0 ~ 2	3 ~ 5	6 ~ 8	9 ~ 10	**10%**	
vi. Conclusion and Recommendations *Provide a summary of the proposed project, realistic recommendations for future work. (CLO4)*	0 ~ 2	3 ~ 5	6 ~ 8	9 ~ 10	**10%**	

vii. Quality of Report/Proposal *Easy to read, contain sound logical structure, free from typos and grammatical errors, comply with the thesis/Proposal guidelines, proper presentation of charts / diagrams / tables / references (APA style).* *(CLO4)*	0 ~ 4	5 ~ 10	11 ~ 16	17 ~ 20	**20%**	
TOTAL					**100**	

Component Title	Presentation			**Percentage (%)**	**100**	
Criteria	**Score and Descriptors**				**Weight (%)**	**Marks**
	Beginning (B)	**Developing (D)**	**Accomplished (A)**	**Exemplary (E)**		
i. Content *Clearly and distinguishable aims and objectives, sufficient background and technical contents, research methodology, Gantt Chart, conclusion by reinstating main points, limitations and future work. (CLO3)*	0 ~ 10	11 ~ 15	16 ~ 20	21 ~ 25	**25%**	
ii. Delivery Skills *Express himself/herself confidently, eye contact and body language, good command of English, no noticeable over-long pauses, time management. (CLO3)*	0 ~ 10	11 ~ 15	16 ~ 20	21 ~ 25	**25%**	
iii. Clarity of Explanation *Well-structured and clear presentation, use of clear visual aids / diagram, correct use of technical terms and descriptions, proper volume. (CLO3)*	0 ~ 10	11 ~ 15	16 ~ 20	21 ~ 25	**25%**	

iv. Handling of Questions *Provide accurate answers, good answering technique. (CLO3)*	0 ~ 10	11 ~ 15	16 ~ 20	21 ~ 25	**25%**	
TOTAL					**100**	