FitQuest: Gamify Your Workout

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***Abstract*—With prolonged siWith prolonged sitting and decreased physical ac- tivity levels among gamers, especially children and adolescents, there is a pressing need to address the negative health effects such as musculoskeletal issues. Our project tackles the sedentary behavior associated with traditional gaming by introducing exergaming, a web- based software enabling gameplay through body gestures and movements for character navigation. By harnessing camera vision technology, users can engage in physical activity while playing web-based games. Our implementation utilizes Python programming to seamlessly integrate this innovative system. The sedentary lifestyle prevalent in gaming culture poses significant health risks, including musculoskeletal issues and decreased physical activity levels, particularly among children and adolescents. Exergaming promotes physical involvement and active gameplay, combating the negative effects of prolonged sitting and sedentary behavior. Through our project, we aim to revolutionize gaming into a medium that not only entertains but also encourages physical activity and well-being.**

***Index Terms*—Active video games, exergame, Physical Activity, exercise, fitness**

I. Introduction

In the current digital era, gaming has taken centre stage in leisure activities, enthralling people of all ages, but especially kids and teenagers. But the popularity of traditional gaming has raised questions about the negative effects it has on physical health and the sedentary behaviour it is linked to. Extended periods of sitting and reduced physical activity have been associated with a number of health problems, including as obesity, cardiovascular illnesses, and musculoskeletal disorders. Our idea offers a novel approach to address these issues, changing the game experience and encouraging a healthy way of living.

Combining gaming with exercise, or exergaming, is a viable solution to the sedentary behaviour that characterises traditional gaming. Our idea uses camera vision technology along with web-based software to allow users to interact with the game with their body movements. This innovative method promotes active engagement and physical activity in addition to improving the gaming experience.

Python programming, which is popular and adaptable and is renowned for its simplicity and flexibility, forms the foundation of our solution. By means of smooth integration, individuals can partake in a variety of online games concurrently with engaging in physical activity. Our idea seeks to transform the gaming industry and encourage a more active and health-conscious gaming culture by escaping the limitations of sedentary gameplay.

Our project is significant because it has the potential to lessen the detrimental impacts on health that extended sitting and sedentary behaviour have on gamers, particularly young people and teenagers. We aim to promote a paradigm shift towards a healthier and more physically engaging gaming experience by offering exergaming as an option. We see a future where gaming not only provides entertainment but also enhances physical well-being through cooperative efforts and cutting-edge technologies.

II. Theory and Related Works

Fenja T. Bruns and Frank Wallhoff [1] introduces a conceptual framework that uses affective computing to modify exergames for older people with the goal of raising motivation and engagement levels for physical activity. The framework incorporates personalization techniques and constant feedback to provide valuable insights into improving motivation and engagement, especially among older adults. Techniques include the use of non-invasive sensors to recordphysiological data, such as wristbands or smartwatches, and machine learning algorithms to infer emotional states from the data gathered.

Alhagbani and Williams [2] conduct a systematic evaluation of how well home-based exercise games help older individuals' balance and lower their risk of falling. The review highlights the potential advantages of exergames in improving balance outcomes and lowering the risk of falls through careful study selection and data synthesis, underscoring the significance of scientific rigor in assessing exergame interventions. A systematic search approach and the use of approved tools,

including JBI tools for quality assessment, are part of the methodologies.

Moreover, Alberto Isaac Perez Sanpablo and team [3] present a novel method for creating exergame systems for pediatric gait therapy using Persuasive System Design (PSD). The authors create a system that is suited to children's psychomotor performance through observational studies and scenario-based design, with a strong emphasis on individualized therapy sessions. The human-centered design process for gamedevelopment and observational studies to determine system requirements are examples of methodologies.

Furthermore, Ari Kusumaningsih and their team [4] conduct a randomized controlled trial assesses the benefits of personalized exergames combined with traditional exercise for older adults' motor performance and quality of life. Results indicate significant improvements in strength and mental health outcomes among participants in the exergames group compared to controls. Methodologies involve a 12-week exercise intervention with outcome measures at various intervals, including strength assessments and quality of life evaluations.

Also, Afonso G, John Munoz and team [5] randomized investigates the benefits of custom exergames for fitness, balance, and health-related quality of life in community-dwelling older adults. Through a randomized controlled trial, the study demonstrates the effectiveness of integrating personalized exergames into traditional exercise interventions, leading to improvements in motor performance and mental well-being. Methodologies include the development of custom exergames using a human-centered design process and the use of controlled trial methodology for evaluation.

III. Proposed System

We suggest incorporating actual body movements into the current gaming navigation control system for enhanced navigation for online web games. A webcam will track and assess the movements of the body. The player's actions can govern the game's character based on how his body moves. In order to interpret the bodily motions, we employ computer vision technologies. The webcam-based stance detection approach for real-time game control. Starting from the import of necessary libraries, including PyAutoGUI for game control and OpenCV for image processing, and including time, math, and visualization modules, the procedure moves forward by first initializing pose detection models with MediaPipe Pose. 'detectPose()', a custom method with parameters for visualization, is added to recognize pose landmarks in photos. To help with hand placements, horizontal alignment, and different movements like jumping and crouching, utility functions are designed to assess pose landmarks. Character movements are made easier by the translation of recognized poses into game commands made possible by integration with PyAutoGUI.The primary loop, which continuously records camera frames, analyzes stances, and modifies game control accordingly—including starting the game and continuing it when a character dies—is at the heart of the system. The methodology's usefulness is enhanced by real-time frame processing and display, user interaction features, and a smooth way for users to control games using physical motions recorded with a webcam. Fig(1) shows the proposed framework for an affective exergame.

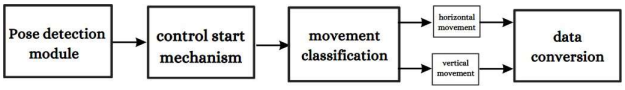


Fig. 1: Proposed framework

The project uses a modular design and a client-server architecture. A user interface on the client side uses computer vision technologies to record motions of the body. The backend system handles data processing and analysis on the server side in order to produce game replies.To track and analyse gestures in real-time, many components such as pose recognition, control mechanism, movement classification, and data conversion collaborate. The use of external libraries and APIs results in increased accuracy and functionality. Scalability, adaptability, and compatibility with multiple game systems are guaranteed by the design. As seen in fig(2) shows architecture diagram for proposed system.

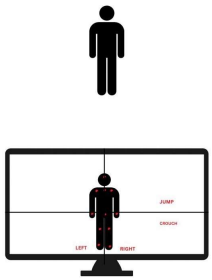


Fig. 2: Architecture Design

A. Computer Vision

The goal of the interdisciplinary discipline of computer vision is to enable computers to comprehend digital images or videos in order to automate processes that are similar to human visual perception. It entails taking pictures or image sequences and extracting, evaluating, and understanding meaningful information from them. Through the use of computer vision technology, this project enhances the online web game navigation experience by incorporating real body movements. Through the use of algorithms and techniques, the system is able to analyse body language and motions taken in real-time by a webcam, enabling the game character to smoothly mimic the player's actions. Pose detection systems allow for fine control over character behaviours such as jumping, crouching, and moving by properly tracking and interpreting movements. Furthermore, computer vision classifies hand gestures for both horizontal and vertical activities, making it easier to start and pause games. With PyAutoGUI integration, position data is

converted and used for efficient game control, making for an engaging gaming experience where physical movements in the real world are translated into virtual actions.

B. Pose Detection

The real-time pose information of the player operating the game is mostly detected by webcams. Different positions are recognised by gestures and body language to match the activities of the character in the game. To process input photos and precisely identify pose landmarks, a pose detection mechanism was created by utilising the Pose class. This makes sure that when the player moves left, right, jumps, or crouchs, the game character will accurately imitate their movements. To guarantee that the final image and the original input image were displayed correctly, the functionality was put through a rigorous testing process. The accuracy of posture landmarks detection was confirmed by examining the output image and pose results, guaranteeing a fluid and engaging gaming experience in which the virtual character mimics the player's movements. The accuracy of posture landmarks identification was confirmed by examining the output image and pose results, guaranteeing a fluid and realistic gaming experience in which the virtual character precisely mimics the player's movements.

C. Control Start Mechanism

The process of initiating the game entails developing a function to recognise when the most noticeable individual in the picture clasps their hands together, signifying the start of the game. Pose landmarks are identified on each frame by performing pose recognition on the webcam through the integration of a video capture object. To be more precise, the system decides whether to start or pause the game based on whether the left and right hands are connected. Furthermore, a control mechanism is designed to facilitate the start and stop of games. The system verifies that it can end the loop and release the video capture object when the 'ESC' key is pressed in order to guarantee functionality. By using a complete approach that enables effective control over the start and pause actions of the game based on hand movement pose detection, gameplay dynamics and user experience are improved.

D. Movement Classification

The movement categorization module has been painstakingly designed to allow the user to control the game character's motions and gestures in perfect rhythm. Precise control is attained by dividing movements into horizontal and vertical categories. To ensure accurate movement detection, a copy of the input image is made in order to clearly display the position and posture labels. Real-time responsiveness is made possible by utilising the VideoCapture object, which makes frame reading and pose identification easier. Extensive verification guarantees the precise recognition of particular motions, such as leaping, squatting, and standing, which are essential for engaging gameplay. To improve user experience and gameplay fluency, the module also verifies that the associated key press actions are in line with the detected movements. This thorough technique guarantees that the player's actions are accurately reflected by the game character, resulting in a dynamic and captivating gaming experience where real-world movements are smoothly translated into virtual ones.

E. Data Conversion

In order to provide smooth control, the detected poses must be combined and converted when integrating pose detection data into the gaming navigation system. As part of this procedure, the PyAutoGUI library is linked with the pose detection findings to provide effective game control. Accuracy is ensured by employing precise stance detection methods and appropriate frame reading. The PyAutoGUI library is smoothly provided with inputs from the pose detection system, the start mechanism, and the movement categorization module. Smooth gameplay is made possible by this integration, which translates the inputs into system keyboard control capabilities. This all-encompassing method guarantees that the pose detection data is transformed and used in the game environment in an efficient manner, improving user interaction and experience. The gaming navigation system achieves a high degree of precision and responsiveness by utilising PyAutoGUI's capabilities and streamlining the posture detection process, providing users with an intuitive and engaging gaming experience.

IV. Results And Discussion

The project uses web-based software and camera vision technology to provide an exergaming solution that combats sedentary behaviour in gaming. It encourages physical exercise during gaming by enabling games through body motions with Python programming. It targets gamers, particularly kids and teenagers, in an effort to counteract the musculoskeletal problems and low levels of physical activity that come with playing traditional video games. The initiative aims to reduce the effects of extended sitting and sedentary behaviour that are common in gaming culture by transforming gaming into a medium that promotes active activity.

Fig. 3: Pose Detection

Examine sample photos to confirm that the pose detection mechanism recognises pose landmarks with accuracy. Fig(3) shows the pose detection for playing exergame. Make that the pose landmarks detection results and the output image are returned accurately. Verify that the output image displays as intended and that the original input image did. To test the

accuracy and resilience of the module, evaluate it in a variety of settings, such as varied lighting, different positions, and different people.

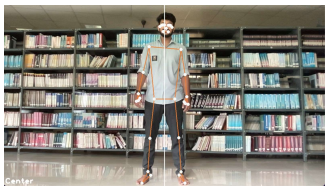
(a) Hands are not joined (b) Both hands are joined

Fig. 4: Control start mechanism

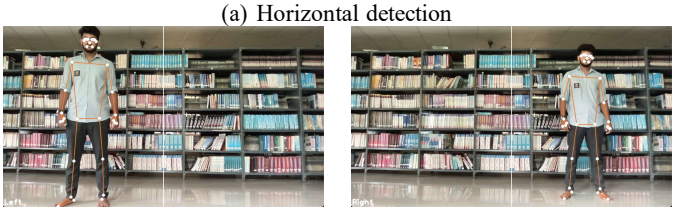
To guarantee that the game starts or resumes correctly, make sure the control start mechanism replicates a variety of hand positions and movements. Make that the video capture object is properly initialised and released. Verify whether pose landmarks in the frame were correctly detected. To ensure that the loop is broken and that the Video Capture object is properly released, end the module by pressing the ”ESC” key. Fig(4) shows control start mechanism.

Verify whether the game has started by comparing the player's initial shoulder positions to ensure precise detection of the start or resume conditions. Take into consideration multiple situations, such as differences in shoulder stances and motions, to confirm when the game started.

Verify that the left and right hands are linked for the predetermined number of consecutive frames to make sure the game starts or continues correctly. To ensure that the starting and resuming mechanism is reliable, assess a range of scenarios with varying hand locations and movements.



(a) Horizontal detection

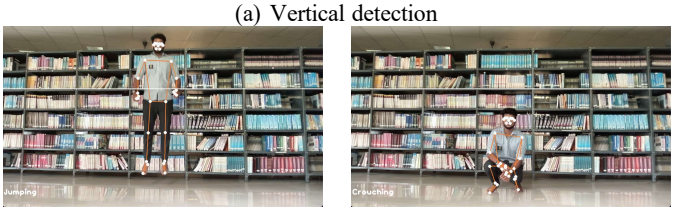


(b) Left movement (c) Right movement

Fig. 5: Horizontal Movement Classification

Check that various postures and motions, such as vertical movements like jumping, crouching, and standing, as well as horizontal movements like right, left, and standing, are accurately identified and classified. In above fig(5) shows the horizontal movement classification. Make sure the photos have the posture labels printed on them correctly. Test the module on a range of people and movement patterns to ensure precise and trustworthy movement classification. Make sure the data is properly converted into the format required for game control in order to confirm that the pose data is linked with PyAutoGUI successfully. Verify the frame reading accuracy and pose landmark detection inside the frames. The module tests precise data conversion and smooth game control with a range of users and stances.In fig(6) shows vertical movement classification.

(a) Vertical detection



(b) Jumping (c) Crouching

Fig. 6: Vertical Movement Classification

Analysing the many parameters, including training accuracy and loss, validation accuracy and loss, and of course model accuracy, can be used to evaluate the results. The accuracy of the model is now 96.55% .

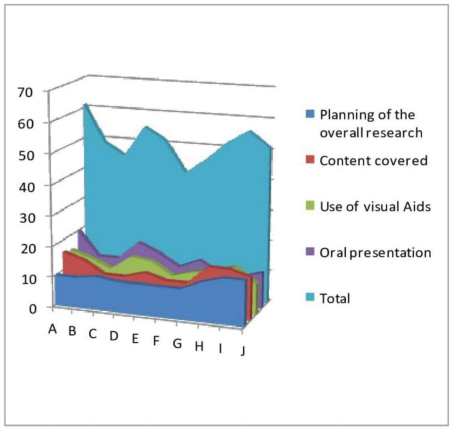


Fig. 7: Performance graph

Fig (7) displays the accuracy and loss over time of the training and validation processes. They demonstrate how training and validation accuracy improved with time. Analysing the model's performance on both the training and validation sets is possible with the loss. It computes the sum of the errors committed on each example in these sets as well as the model's performance on each one.

Exergaming may eventually be extended beyond web-based platforms to include virtual reality (VR) and augmented reality (AR) settings, providing players with even more immersive

gaming experiences. Wearable technology integration may enable real-time feedback on health measurements and physical activity levels, enabling customised gaming experiences and health tracking. Partnerships between game creators and medical experts may also result in the development of customised exergaming programmes that cater to the health requirements and preferences of various age groups. Additionally, investigating gamification strategies to reward and motivate physical exercise in exergaming may improve user participation and sustained adherence. Lastly, studies on the efficacy and long-term health advantages of exergaming interventions may support the program's function in enhancing wellbeing and physical activity, which may encourage its integration into larger public health programmes and clinical settings.

V. Conclusion

In conclusion, our research tackles the pressing need to lessen the detrimental impacts on health that extended sitting and a decrease in physical activity have on gamers, particularly young people and adolescents. Using web-based software and camera vision technologies, we provide exergaming—a way to play video games while encouraging physical exercise and preventing sedentary behaviour. We are able to smoothly incorporate this revolutionary system using Python programming, transforming traditional gaming into a medium that promotes active gameplay and physical engagement. Our research intends to improve the health and well-being of gamers, especially the younger generation, by addressing musculoskeletal problems and encouraging physical activity. Exergaming, which has the ability to change gaming culture, is a viable solution to the sedentary lifestyle that is common in gaming communities.

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