Pass Task 3.2: Summary of Applicable Research Methods

1. List of Resources

Academic Journals: Utilization of online databases such as IEEE Xplore, PubMed, Elsevier, and other resources accessible through the Deakin Online Library. Exploring citation networks within these databases is intended to identify key works and related peer-reviewed studies.

Datasets: While there are publicly accessible datasets about certain aspects of the project, I plan to customize these datasets to align with our specific requirements. This customization will involve the collection of new data as well as utilizing past data gathered by the supervisor.

2. Methodology

a. Research Approaches

Leverage numerical data obtained from sensors to measure and quantify distinct variables. This approach is well-suited for acquiring objective and measurable insights into user interactions, gait patterns, and health metrics, aligning seamlessly with the quantitative data collected from Smart sensors.

b. Suitability

The most suitable research approach for the project is the Quantitative Approach. Combining quantitative data from multiple sensors will provide a comprehensive understanding of user interactions, system performance, and health impact. This approach aligns with the project's objective of creating a holistic view of the IOT Based Framework.

This approach is consistent with established methodologies in Computer Vision and Machine Learning-Based Gait Pattern Recognition for Flat Fall Prediction, providing a robust foundation for the proposed IOT-based Framework (Biao Chen et al., 2022).

References

Chen, B.; Chen, C.; Hu, J.; Sayeed, Z.; Qi, J.; Darwiche, H.F.; Little, B.E.; Lou, S.; Darwish, M.; Foote, C.; et al. Computer Vision and Machine Learning-Based Gait Pattern Recognition for Flat Fall Prediction. Sensors 2022, 22, 7960. https://doi.org/10.3390/s22207960

c. Experiments

Experiment 1: Assessing Gait Analysis Algorithms

Objective: Evaluate the performance of gait analysis algorithms in identifying and classifying diverse gait patterns.

Variables: Independent Variable: Gait analysis algorithms, Dependent Variables: Accuracy, precision, recall, and F1 score of gait pattern classification.

Controls: Use a diverse and representative dataset for training and testing the algorithms.

Experiment 2: 3D LIDAR Technology Comparison

Objective: Compare the effectiveness of gait monitoring using 3D LIDAR technology against traditional methods.

Variables: Independent Variable: Gait monitoring technology (3D LIDAR vs. traditional sensors). Dependent Variables: Joint movement analysis accuracy, posture assessment, and balance evaluation.

Controls: Standardized gait scenarios for data collection.

d. Data Acquisition and Analysis

Quantitative data will be acquired from sensors measuring gait dynamics, and health parameters that will be analyzed using statistical methods (mean, median, standard deviation) with Python tools, while qualitative insights from user feedback surveys and interviews will be subjected to thematic analysis.

Advanced analysis will involve machine learning algorithms (Markov Models, Support Vector Machines), and findings will be presented using visualization tools such as Matplotlib and Seaborn.

e. Evaluation

1. Algorithm Performance Assessment

Evaluate the performance of ML algorithms using metrics such as precision, recall, and F1 score to measure their effectiveness in gait analysis and health assessment.

2. Statistical Analysis

Apply statistical measures to analyze numerical data, including gait metrics, health parameters, and user interactions, while conducting correlation analysis to identify patterns and dependencies among different variables in the collected data.

f. Potential Risks

1. Ethical Considerations in Data Collection

The collection of health-related user data poses a potential threat to privacy and sensitive information. Hence, ethical guidelines are essential to safeguard user rights and uphold confidentiality.

2. Biases in Machine Learning Algorithms

ML algorithms may introduce biases if the training data lacks diversity, potentially leading to skewed or discriminatory results which could impact the fairness and inclusivity of the system.