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EchoCare: Fall Detector and Emergency Alert System with Impact Classification using Novel Heuristic Fall Detection Algorithm

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ABSTRACT

Falls remain a major public health concern worldwide, especially among elders and toddlers, who are prone to injury due to frailty and underdeveloped motor control. In the Philippines, over half of the population has reported experiencing fall incidents, with a portion resulting in serious injuries and fractures. These accidents often lead to delayed emergency response and long-term physical decline. To address these issues, the researchers developed EchoCare, an IoT-based wearable device that detects falls, classifies their severity, and sends automated alerts with location information through SMS communication. The system integrates the Novel Heuristic Fall Detection Algorithm (NHFDA), which incorporates an impact classification feature that analyzes the fall impact to determine the level of severity after it occurred. Through testing phase, it would enable the device to categorize the severity of a fall into mild, moderate, or severe which would allow caregivers and parents to respond based on the level of urgency.

Keywords: *EchoCare, Emergency Alert System, Elder falls, Fall Detection, Fall Severity, Impact Classification, Novel Heuristic Fall Detection Algorithm (NHFDA), Toddler falls*

INTRODUCTION

Falls remain a pressing public health concern worldwide, especially for individuals with mobility difficulties such as the elderly and toddlers. In the Philippines, according to World Health Organization, approximately 53.6% of Filipinos reported experiencing fall accidents, with 2.4% of this group sustaining serious injuries and fractures resulting from those incidents. Individuals who suffered severe fall accidents have seen a decline in physical abilities and a general reduction in physical capabilities. When a fall accident happens, the delay in emergency response often increases the risk of complications. Although some fall detection systems provide technological solutions, various factors still influence the acceptance of fall detection devices driven by their concerns regarding patients' health issues, reliance on human support, degree of personal comfort, awareness of market choices, viewpoint on technology, financial concerns, and expectations concerning fall detection technology.

To address these issues, the researchers developed EchoCare: Fall Detector and Emergency Alert System with Impact Classification, an IoT-based wearable device that detects falls, classifies their severity, and sends automated alerts with GPS and address information

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via SMS. Using the Novel Heuristic Fall-Detection Algorithm (NHFDA) and the MPU6050 sensor, the system aims to ensure timely assistance and reduce response delays.

Statement of the Problem

This study aimed to develop EchoCare: Fall Detector and Emergency Alert System with Impact Classification Using Novel Heuristic Fall-Detection Algorithm (NHFDA) for elders and toddlers.

Specifically, it sought to answer the following questions:

1. What fall accidents and emergency response challenges are commonly experienced by vulnerable Filipino groups, particularly elders and toddlers, in obtaining immediate assistance?
2. How can a fall detection device be developed that is wearable by both elders and toddlers, cost-effective and affordable, capable of sending automated alert signals through a portable caregiver buzzer and SMS notifications via a GSM module, capable of transmitting the user's registered home address and GPS coordinates through SMS, and capable of classifying fall impact severity using the MPU6050 gyro-accelerometer sensor?
3. How does the Novel Heuristic Fall-Detection Algorithm (NHFDA) perform in terms of accuracy, precision, recall, F1-score, and response time?
4. How effective is the EchoCare system based on expert evaluation using the ISO 25010:2023 software quality standards in terms of functional suitability, reliability, performance efficiency, interaction capability, and security?

Scope and Delimitations

This study focused on the development and evaluation of EchoCare, a three-device fall detection system integrated with a Novel Heuristic Fall-Detection Algorithm (NHFDA). The system consists of a wearable vest for fall detection, a caregiver alarm device for immediate notification, and an SMS/GPS module for emergency alerts and location tracking. The system was designed to provide real-time fall detection and response for elderly and toddler users.

The study is limited to fall detection and does not address other medical emergencies such as heart attacks, strokes, or head injuries. Detection accuracy may be affected by variations in body type, fall patterns, device placement, and user movements, which may result in false positives or missed detections. The system supports only one wearer per alarm and SMS unit, although multiple caregiver contacts can be registered. Its effective communication range is approximately 20 meters, and performance may be affected by weak mobile network coverage. Additionally, the system relies on battery power and requires regular charging for continuous operation.

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Review of Related Literatures

Falls remain one of the leading causes of injury among older adults and young children worldwide. Research has shown that elderly individuals are particularly vulnerable to falls due to age-related frailty, chronic illnesses, and declining physical abilities, while toddlers are at risk because of underdeveloped motor skills and natural curiosity (World Health Organization, 2021; Omaki et al., 2021). Delayed assistance after a fall can increase the likelihood of severe complications and long-term health consequences, emphasizing the need for effective fall detection systems.

Recent advancements in wearable technology have enabled the development of fall detection devices that utilize motion sensors such as accelerometers and gyroscopes. A systematic review by Wang et al. (2024) found that wearable fall detection systems achieved high sensitivity and specificity in identifying fall incidents, making them a practical solution for continuous monitoring. Similarly, Warrington (2021) demonstrated that sensor-based systems can accurately distinguish fall events from normal daily activities, although false alarms remain a challenge in real-world applications.

Several studies have also highlighted the effectiveness of inertial measurement units (IMUs), particularly the MPU6050 sensor, in wearable healthcare devices. Najmurrokhman et al. (2021) developed a threshold-based fall detection system using the MPU6050 and reported high detection accuracy while maintaining low computational requirements. Their findings suggest that accelerometer and gyroscope data can reliably identify sudden changes in motion associated with falls, making the sensor suitable for portable and low-cost monitoring devices.

In addition to fall detection, researchers have emphasized the importance of classifying the severity of falls. Shen et al. (2025) reported that the direction of impact and body position during a fall significantly influence injury severity. Likewise, Traverso et al. (2024) found that sideways falls were more likely to result in fractures and serious injuries than forward or backward falls. These findings support the integration of impact classification mechanisms into fall detection systems to assist caregivers in determining the urgency of response.

The choice of algorithm is another critical factor in wearable fall detection devices. According to Fu et al. (2024), rule-based and heuristic algorithms remain highly suitable for Internet of Things (IoT) applications because of their low power consumption, fast processing speed, and minimal hardware requirements. Furthermore, Saleh and Jeannes (2023) demonstrated that fuzzy logic and heuristic approaches achieved high levels of accuracy and recall in distinguishing fall events from activities of daily living. These studies indicate that lightweight algorithms can provide reliable fall detection without the computational demands of complex machine learning models.

Collectively, the reviewed literature demonstrates the need for affordable and reliable wearable fall detection systems that can identify falls, classify their severity, and provide immediate alerts to caregivers. These findings provide the foundation for the development of EchoCare, which integrates wearable sensing technology, impact classification, and emergency notification features to improve the safety of elders and toddlers.

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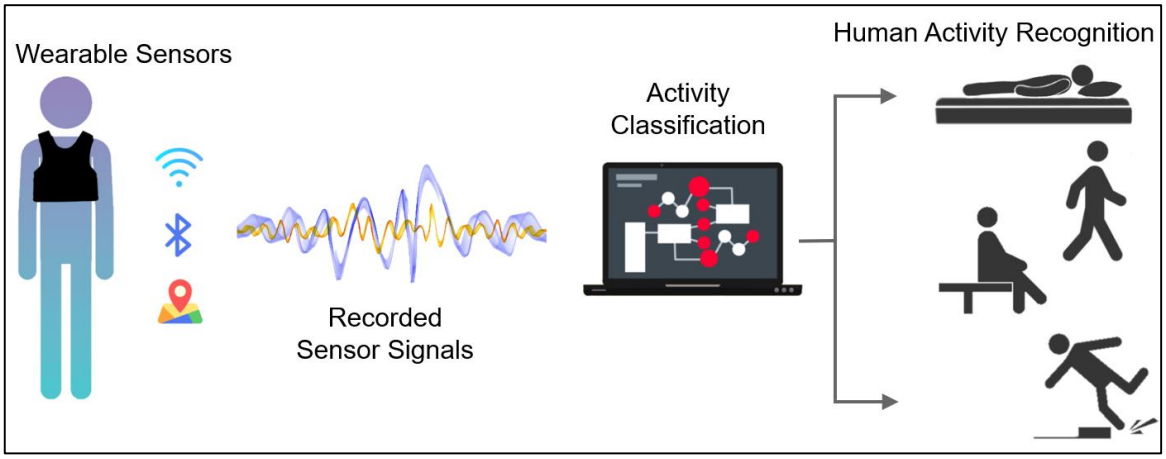
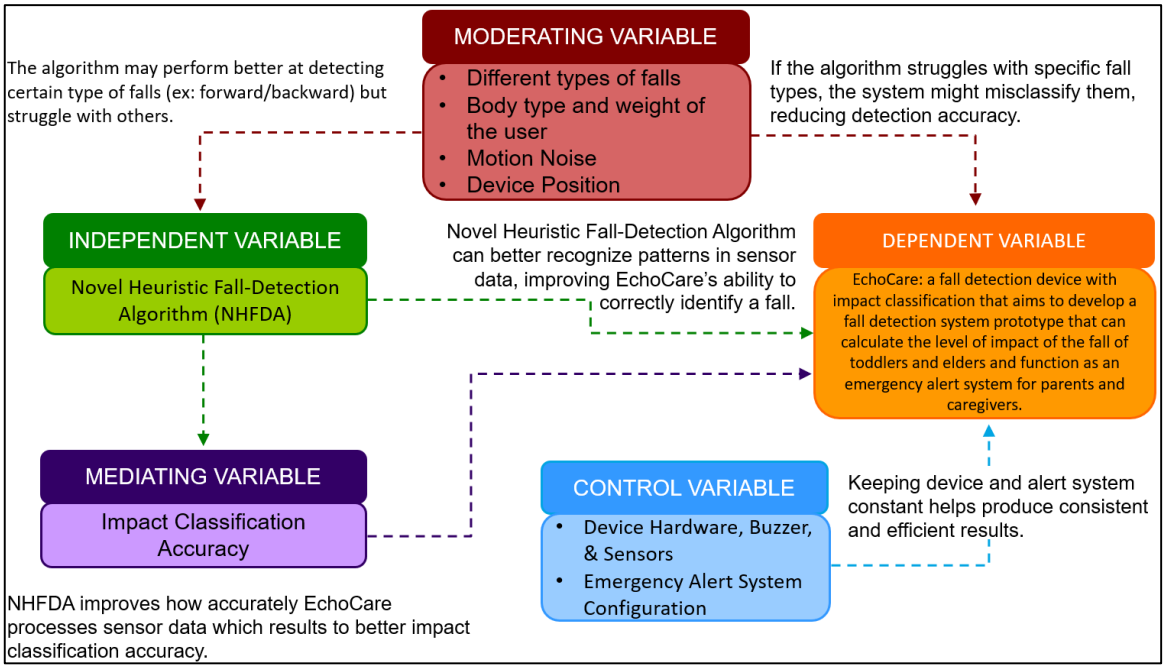
Theoretical Framework



The Human Activity Recognition (HAR) is a theoretical framework used for EchoCare by offering a systematic approach to monitoring and analyzing human movements using sensor data. Through activity recognition principles, the framework supports accurate detection of falls and abnormal movements, enabling real-time monitoring and emergency response. Its application in EchoCare enhances the system's reliability in distinguishing normal activities from fall incidents, contributing to improved safety for elderly and toddler users.

Conceptual Framework



The conceptual framework illustrates the relationship between the variables affecting the performance of the EchoCare fall detection system. The independent variable is the Novel Heuristic Fall-Detection Algorithm (NHFDA), which analyzes movement patterns to detect falls. Classification accuracy serves as the mediating variable, ensuring that falls are correctly categorized by severity. The dependent variable is the EchoCare prototype, which provides fall detection and emergency notifications for elderly and toddler users.

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The system's performance may be influenced by moderating variables such as fall type, body weight, motion noise, and device placement. Meanwhile, hardware components, sensors, and emergency alert settings were controlled to ensure that performance differences were primarily attributed to the NHFDA. This framework emphasizes the role of the algorithm in improving fall detection accuracy and system reliability.

METHODOLOGY

This research study examined the effectiveness and favorability of fall detection for the target population.

Research Design

The study employed a mixed-method research design combining descriptive and quantitative approaches. Descriptive methods were used, including interviews with caregivers, healthcare professionals, and orthopedic experts, to gather insights into fall incidents and response challenges. Quantitative methods involved surveys and system evaluations to assess functionality, reliability, performance efficiency, interaction capability, and security.

Research Steps

Following a comprehensive analysis of the current literature, the researchers employed a mixed-methods research design that integrated descriptive and quantitative approaches. The descriptive method was first utilized to gather important information via pre-interviews with caregivers, healthcare personnel, orthopedic physicians, and other important individuals. The purpose of these interviews was to obtain insights regarding the necessity of the study, investigate the reasons for fall incidents in Calamba City, Laguna, and to identify individuals who are most vulnerable.

Subsequently, the researchers utilized the quantitative approach to assess the system's efficacy. The researchers then shared the survey questionnaires via face-to-face to collect information about the respondents' experiences with EchoCare. This approach allowed the researchers to evaluate the EchoCare's system effectiveness, device's reliability, system's ease of use, and safety.

Data Collection and Sample Selection

Data collection was conducted in two phases: system testing and evaluation. A descriptive-quantitative research approach was used to assess the performance of the EchoCare system and its Novel Heuristic Fall-Detection Algorithm (NHFDA). The study involved 96 respondents, including caregivers of toddlers aged 1–4 and elderly individuals aged 70 and above.

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System evaluation was carried out through survey questionnaires and guided interviews to determine the usability and effectiveness of EchoCare. Additionally, four volunteers performed a total of 180 fall simulation trials each in a controlled environment to generate data for measuring the algorithm's accuracy, precision, recall, and F1 score. All data collection activities were conducted with informed consent and in compliance with ethical and data privacy requirements.

Data Analysis Methods

Data were analyzed using both descriptive and quantitative methods. Survey responses regarding the usability and effectiveness of EchoCare were evaluated using a four-point Likert scale and weighted mean based on the ISO 25010 quality standards. System performance was evaluated with a confusion matrix to calculate accuracy, precision, recall, and F1 Score. For the impact severity classification model, macro-average metrics were computed to evaluate the overall performance across mild, moderate, and severe fall categories. These statistical methods were used to measure the reliability, effectiveness, and classification performance of the EchoCare system.

Research Hypotheses and Validation

The study hypothesized that the EchoCare system, powered by the Novel Heuristic Fall-Detection Algorithm (NHFDA), would effectively detect fall incidents, classify impact severity, and provide timely emergency alerts for elders and toddlers. Specifically, it was expected that the algorithm would achieve satisfactory levels of accuracy, precision, recall, F1-score, and response time in distinguishing fall events from normal daily activities.

Furthermore, it was proposed that experts would assess the created system favorably for Functional Suitability, Reliability, Performance Efficiency, Interaction Capability, and Security, as outlined by the ISO 25010:2023 software quality standards. The system's validation was carried out by testing algorithm performance and assessing expert feedback via survey questionnaires. The outcomes from these evaluations were examined to establish if the created prototype achieved the study's aims and offered a dependable, economical, and feasible solution for detecting falls and responding to emergencies.

Study Limitations and Ethical considerations

Prior to data collection, the study adhered to ethical guidelines by securing approval from the school administration and collaborating with local government agencies, such as the City Social Services and Youth Development Department, the Office of Senior Citizens Affairs, and the City Population Management Office. Consent forms were provided to all participants, and the research strictly followed the regulations of the Data Privacy Act of 2012. Formal letters were also dispatched to professionals and barangay officials to request

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permission for interviews and community surveys, maintaining ethical standards during the research.

RESULTS AND DISCUSSION

SOP 1. What fall accidents and emergency response challenges are commonly experienced by vulnerable Filipino groups, particularly elders and toddlers, in obtaining immediate assistance?

Interviews conducted with caregivers, parents, and healthcare professionals revealed that elders aged 65–70 years and toddlers aged 1–4 years are the most vulnerable groups to fall-related accidents. Health professionals attributed falls among elders to age-related weakening of muscles and joints, reduced balance, and declining mobility, while toddlers were found to be prone to falls due to developing motor skills and hyperactive behavior.

Common Causes of Falls: Respondents noted that aging, ignoring physical limitations, environmental dangers, lack of supervision, and children's hyperactivity are the main causes of falls. Falls in toddlers often took place in home settings like bedrooms and stairways, whereas older adults typically encountered falls because of fragility and hazardous environments.

Emergency Response Challenges: Families reported assistance frequently came too late due to reliance on manual communication methods and the need to juggle multiple responsibilities. Senior citizens living independently or depending on nearby family members showed extended response times, emphasizing the necessity for an automated fall-detection and notification system.

SOP 2. How can a fall detection device be developed that is wearable by both elders and toddlers, cost-effective and affordable, capable of sending automated alert signals through a portable caregiver buzzer and SMS notifications via a GSM module, capable of transmitting the user's registered home address and GPS coordinates through SMS, and capable of classifying fall impact severity using the MPU6050 gyro-accelerometer sensor?

The findings revealed that the developed EchoCare system successfully achieved all intended functional objectives. Respondents strongly agreed that the wearable vest design could be used by both elders and toddlers for constant and reliable monitoring of fall detection.

Automated Alert and Communication Features: The integration of a caregiver buzzer and GSM-based SMS notification system provided immediate and reliable emergency alerts. Respondents reported that these features enabled faster communication between users and caregivers during fall incidents.

Location Transmission: The system’s ability to automatically send the user's registered address and GPS coordinates during emergencies received positive acceptance from respondents. This feature was considered valuable for improving emergency response accuracy and reducing delays in locating the user.

Impact Severity Classification: Using the MPU6050 sensor and the Novel Heuristic Fall-Detection Algorithm (NHFDA), the system successfully classified falls into mild,

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moderate, and severe categories. This enabled caregivers to prioritize responses according to the severity of the incident.

SOP 3. How does the Novel Heuristic Fall-Detection Algorithm (NHFDA) perform in terms of accuracy, precision, recall, F1-score, and response time?

Performance evaluation showed that the NHFDA achieved strong and reliable results in detecting fall incidents and classifying fall severity.

Fall Detection Performance: The algorithm recorded an average accuracy of 93.61%, precision of 90.00%, recall of 98.36%, and F1-score of 94.00% in distinguishing fall and non-fall activities. These results indicate that the algorithm was highly effective in identifying actual fall events while maintaining a balanced level of precision and sensitivity.

Impact Classification Performance: For severity classification, the model achieved an average accuracy of 90.83%, precision of 91.26%, recall of 90.83%, and F1-score of 90.94%. These results demonstrate consistent performance across mild, moderate, and severe fall categories.

Response Time: The system transmitted alerts with an average response time of 775.11 milliseconds, with most detections occurring in less than one second. This rapid response supports the real-time requirements of emergency alert systems and ensures timely caregiver intervention.

SOP 4. How effective is the EchoCare system based on expert evaluation using the ISO 25010:2023 software quality standards in terms of functional suitability, reliability, performance efficiency, interaction capability, and security?

The effectiveness of EchoCare was evaluated by 97 respondents using ISO 25010:2023 software quality standards. Results showed strong agreement across all quality metrics, indicating that the system effectively meets its intended purpose.

Functional Suitability: EchoCare received a weighted mean of 3.63 (Strongly Agree), indicating that respondents believed the system successfully performs its intended functions, including fall detection, alert notification, and impact classification.

Reliability: The system obtained a weighted mean of 3.58 (Strongly Agree), suggesting consistent operation and dependable communication during emergency situations.

Performance Efficiency: Performance Efficiency received the highest weighted mean of 3.64 (Strongly Agree), indicating rapid processing of fall events and timely delivery of emergency alerts.

Interaction Capability: Interaction Capability achieved a weighted mean of 3.48 (Strongly Agree). Although respondents generally found the system usable, some elders and non-technical users experienced minor difficulties in wearing the device and interpreting alerts, suggesting opportunities for usability improvements.

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Security: Security obtained a weighted mean of 3.62 (Strongly Agree), indicating confidence in the system's ability to protect user information and maintain secure communication.

SUMMARY

The study focused on the development and evaluation of EchoCare, an IoT-based wearable fall detection and emergency alert system designed for elders and toddlers. Through interviews, surveys, and controlled testing, the researchers identified common causes of falls, including mobility limitations, environmental hazards, lack of supervision, and delayed emergency response. The developed system successfully integrated wearable sensors, GSM communication, GPS tracking, and the Novel Heuristic Fall-Detection Algorithm (NHFDA) to detect falls and classify impact severity. Testing results revealed high levels of accuracy, precision, recall, and responsiveness, demonstrating the system's capability to provide real-time monitoring and emergency notifications. Furthermore, evaluations based on ISO 25010:2023 standards showed that the system was effective, reliable, efficient, secure, and suitable for its intended users.

CONCLUSIONS

The findings of the study indicate that EchoCare is an effective and practical solution for improving the safety of elders and toddlers who are vulnerable to fall-related incidents. The integration of the Novel Heuristic Fall-Detection Algorithm enabled accurate fall detection and impact severity classification, while the automated alert system facilitated faster communication between users and caregivers. The system successfully achieved its intended objectives and received positive evaluations from respondents for functionality, reliability, performance efficiency, interaction capability, and security. Although some limitations were observed, such as communication range constraints and occasional false detections, the overall results demonstrate that EchoCare has strong potential as an assistive technology to enhance emergency response and reduce fall-related risks.

RECOMMENDATIONS

Based on the study's findings and conclusions, the following recommendations are proposed. Future researchers may further improve the fall detection algorithm's accuracy and reliability by utilizing larger, more varied datasets and investigating different machine learning methods. Extra communication techniques, like cloud-based messaging, email alerts, and automated emergency calls, could also be incorporated to improve alert distribution. Enhancements in wearable design must be considered to boost user comfort and convenience. Additionally, adding elements like vital-sign tracking, caregiver interfaces, and AI-driven motion assessment could improve the system's capabilities.

Continuous real-world testing and evaluation are also recommended to ensure the long-term effectiveness, usability, and adaptability of the EchoCare system.

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Sincere appreciation is also given to the panel members for their insightful comments and valuable suggestions. The researchers also thank the validators, Prof. Jonimari Ross Valencia, Prof. Junico Yaneza, Prof. Janice Sombillo, and Dr. Erickson G. Zoleta, for their expertise and assistance during the system testing and validation phase.

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Finally, the researchers thank their families and friends for their unwavering support and encouragement, and John Dave Pega for his valuable suggestions and contributions. Your belief in us reminded the team that perseverance, collaboration, and faith can overcome any challenge.

AI DECLARATION

We hereby declare that this thesis project entitled "EchoCare" is our original work, except where proper references and acknowledgments have been provided. We confirm that artificial intelligence (AI) tools were used only to assist in the preparation of this thesis. AI was utilized for grammar checking, paraphrasing, improving sentence structure, formatting, and refining the presentation of ideas. All research, system design, software development, data analysis, testing, results, and conclusions were completed, verified, and reviewed by the researchers.

The following AI tools were utilized in this work:

- ChatGPT (OpenAI) – Grammar checking, paraphrasing, sentence refinement, formatting assistance, and idea organization.
- Google Gemini – General writing assistance and proofreading.
- GitHub Copilot – Code suggestions and programming assistance during software development.

AI-generated outputs were carefully reviewed, validated, and edited by the researchers before inclusion in this manuscript. The researchers accept full responsibility for the accuracy, originality, academic integrity, and authenticity of the work presented. We certify that all sources of information, including AI-assisted content, have been properly acknowledged where applicable.

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REFERENCES

World Health Organization. (2021, April 26). Falls. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/falls

Omaki, E., Shields, W., Masoud Rouhizadeh, Delgado-Barroso, P., Stefanos, R., & Andrea Carlson Gielen. (2023). Understanding the circumstances of paediatric fall injuries: a machine learning analysis of NEISS narratives. Injury Prevention, 29(5), 384–388. https://doi.org/10.1136/ip-2023-044858

Wang, Y., & Deng, T. (2024). Enhancing elderly care: Efficient and reliable real-time fall detection algorithm. DIGITAL HEALTH, 10. https://doi.org/10.1177/20552076241233690

Warrington, D. J., Shortis, E. J., & Whittaker, P. J. (2021). Are wearable devices effective for preventing and detecting falls: an umbrella review (a review of systematic reviews). BMC Public Health, 21(1). https://doi.org/10.1186/s12889-021-12169-7

Najmurrokhman, A., Komarudin, U., & Wibisono, A. (2021). Development of Falling Notification System for Elderly Using MPU6050 Sensor and Short Message Service. https://www.atlantis-press.com/article/125963709.pdf

Shen, J., Sit, C. H., Hui, S. S., Choi, J. W., & Yang, Y. (2025). Volitional protective responses to reduce impact severity during falls: A systematic review and meta-analysis. Clinical Biomechanics, 128, 106608. https://doi.org/10.1016/j.clinbiomech.2025.106608

Traverso, A., Bayram, A., Giacomo Rossettini, Chiappinotto, S., Alessandro Galazzi, & Palese, A. (2024). Investigating the biomechanics of falls in older adults in long-term care using a video camera: a scoping review. BMC Geriatrics, 24(1). https://doi.org/10.1186/s12877-024-05395-2

Fu, S., Thorsteinsdottir, B., Zhang, X., Lopes, G. S., Pagali, S. R., LeBrasseur, N. K., Wen, A., Liu, H., Rocca, W. A., Olson, J. E., Sauver, J. St., & Sohn, S. (2022). A hybrid model to identify fall occurrence from electronic health records. International Journal of Medical Informatics, 162, 104736. https://doi.org/10.1016/j.ijmedinf.2022.104736

Saleh, M., & Jeannes, R. L. B. (2019). Elderly Fall Detection Using Wearable Sensors: A Low Cost Highly Accurate Algorithm. IEEE Sensors Journal, 19(8), 3156–3164. https://doi.org/10.1109/jsen.2019.2891128