# Fall Detection for Elderly People Living Alone Based on Yolov5 and ARKit

Hui Jin, Jayadithya Nalajala, Saniya Pandita, Sai Jahnavi Devabhakthuni

School of Computing and Engineering, University of Missouri-Kansas City, Kansas City, United States

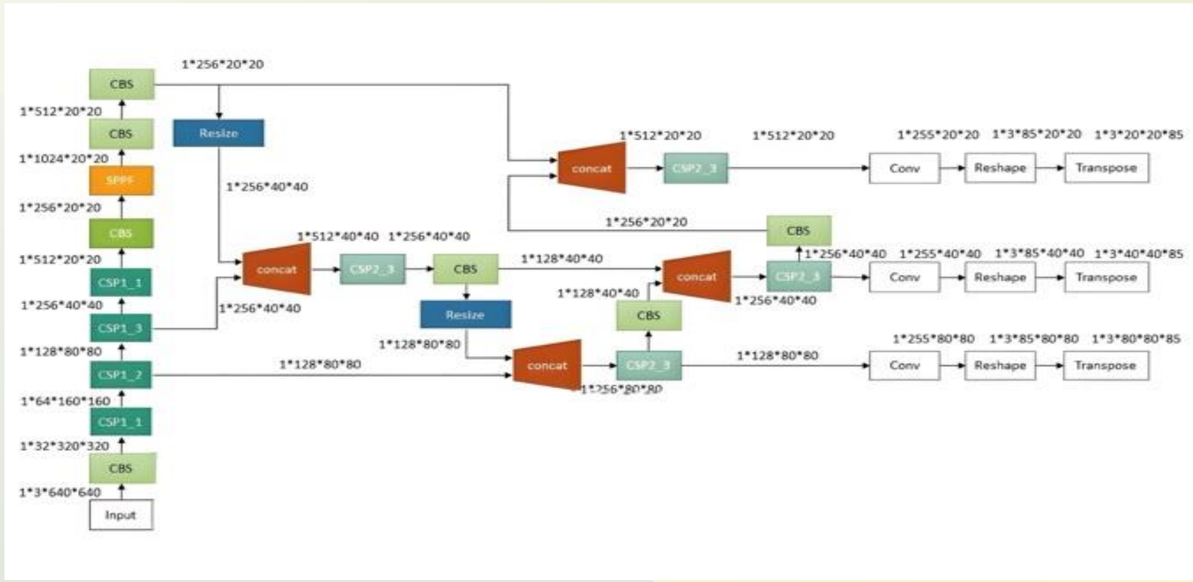
## Introduction

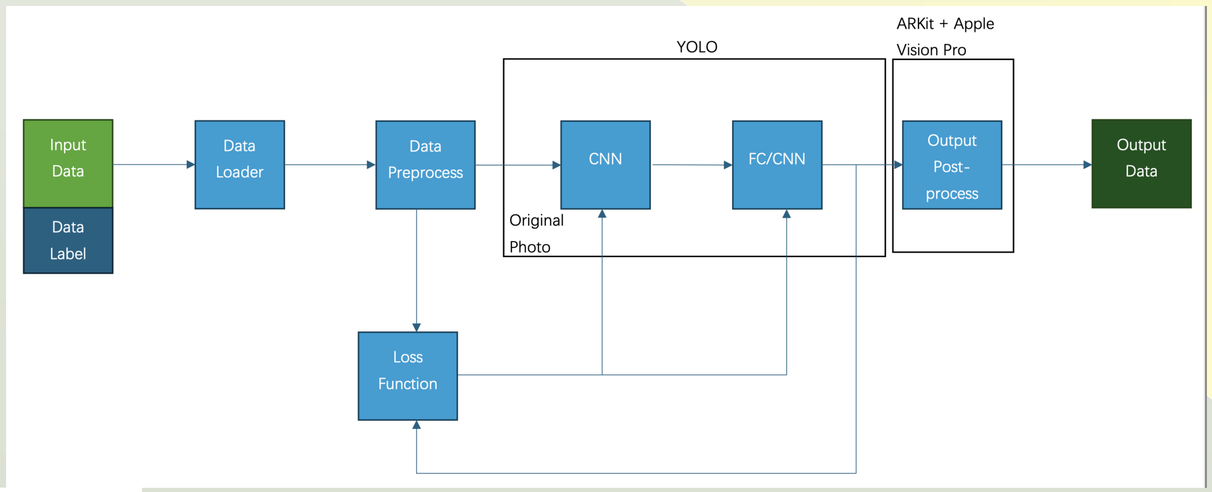
As the problem of aging in society continues to intensify, the life safety of elderly people living alone has gradually attracted widespread attention. The evolving social environment has posed new challenges to elderly safety management. In the current context, the frequent occurrence of falls among the elderly not only reflects their physiological vulnerability but also exposes the inadequacies of existing safety protection systems in responding to such incidents. Falls often lead to serious injuries, diminish the quality of life, and even threaten the survival of elderly individuals. Therefore, developing a technology that can quickly and accurately detect falls among elderly people living alone and enable timely responses is of great significance in enhancing their life safety.

This paper proposes a fall detection algorithm for elderly people living alone based on ARKit, YOLOv5, and Apple Vision Pro, aiming to provide a practical and effective monitoring solution. By integrating YOLOv5's fast visual detection, ARKit's robust spatial perception, and Apple Vision Pro's immersive and real-time environmental sensing capabilities, the algorithm can detect fall events swiftly and accurately. This timely detection capability helps reduce rescue response times and mitigates the potential physical and psychological harm that falls can inflict on elderly individuals living alone.

## System Architecture

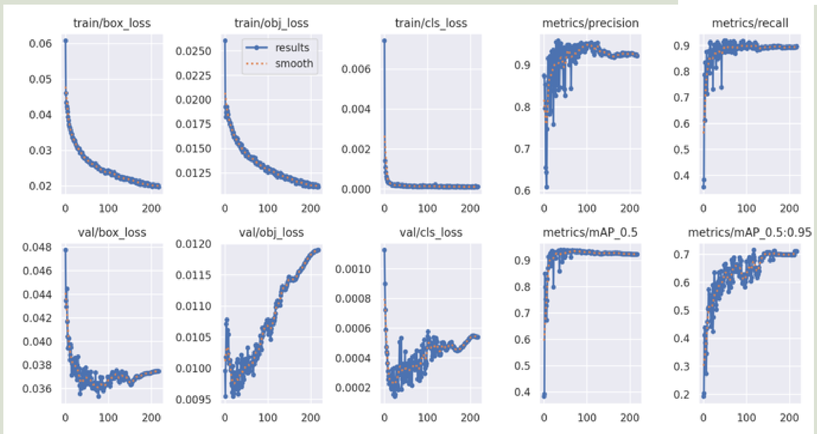
YOLOv5 network structure diagram and ARkit-based YOLOv5 algorithm flow chart:




## RESULTS

We conducted two different tests to compare the algorithm. The first test evaluated the accuracy of fall detection without ARKit, while the second test evaluated the accuracy of fall detection with ARKit. The fall behavior can be detected without ARKit, and the model's confidence in this prediction is 0.83. There may be a problem of false positives, and the model may misjudge some non-fall postures (such as sitting) as falls. The image of the detection results shows that the algorithm can effectively detect the fall event and annotate the event with a high confidence of 0.85. Using ARKit and Apple Vision Pro enhance the model's ability to detect falls in real-world environments, especially in understanding scene depth and spatial position. A falls detection box is not assigned just because the person is only half.





## CONCLUSION

This paper focuses on the design of a fall detection algorithm for elderly people living alone, based on ARKit, YOLOv5, and Apple Vision Pro, and conducts an in-depth analysis of the fall risks faced by this demographic. Through experimental analysis, the proposed algorithm demonstrates notable advantages and potential in fall detection tasks. By integrating ARKit's spatial perception, YOLOv5's object detection capabilities, and Apple Vision Pro's real-time environmental awareness and immersive spatial computing, the algorithm achieves accurate and comprehensive fall identification.

Comparative experiments with traditional fall detection technologies indicate that the proposed approach offers superior accuracy and real-time performance. However, some challenges and limitations still persist. In real-world applications, the robustness and stability of the algorithm require further enhancement. The system's operational efficiency and real-time responsiveness must be optimized to meet the demands of large-scale, continuous monitoring. Additionally, the scalability and adaptability of the algorithm need to be further explored to ensure effective performance across diverse fall scenarios and elderly user groups.

Future work includes optimizing the algorithm's model architecture and parameter configuration to further improve accuracy and efficiency; enhancing the robustness and adaptability of the algorithm, particularly in handling complex environments and posture variations with the support of spatial awareness provided by ARKit and Apple Vision Pro; exploring integration with wearable or smart hardware devices to boost real-time performance and user experience; and conducting extensive real-world testing and user feedback collection to validate the reliability and practical value of the system.

## REFERENCES

H. Le, M. Nguyen, W. Yan, and H. H. Nguyen, "Augmented Reality and Machine Learning Incorporation Using YOLOv3 and ARKit," Applied Sciences, vol. 11, no. 13, p. 6006, 2021.

A. Gupta, R. Srivastava, H. Gupta, and B. Kumar, "IoT based fall detection monitoring and alarm system for elderly," in 2020 IEEE 7th Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), 2020, pp. 1-5.

K. M. Sharook, A. Premkumar, R. Aishwaryaa, J. M. Amrutha, and L. R. Deepthi, "IFall Detection Using Transformer Model," Lecture Notes in Networks and Systems, pp. 58-66, 2022.

## ACKNOWLEDGMENT

This research was conducted as part of the Computer Science CS 5588 Data Science Capstone course under the guidance of Yugyung Lee, Ph.D., Professor. Additionally, it was supported by the technical resources by Sanda University and University of Missouri-Kansas City.