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ROBOTIC ASSISTANCE FOR ELDERLY CARE

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Abstract: In today's fast-paced world, families often struggle to provide continuous care for elderly relatives, raising concerns about the risk of falls and related injuries. While existing fall detection systems offer a solution, reliance on wearable sensors presents practical challenges and discomfort. To overcome this, an innovative automatic fall detection and alert system has emerged. Utilizing computer vision techniques for pose detection and integrating a sophisticated deep learning model, this system offers non-intrusive monitoring without wearable devices. Its swift detection of falls and instant alerts signify a significant advancement in elder care, tackling healthcare challenges associated with aging populations.

Keywords: Computer vision, Pose detection, Deep learning model.

I. INTRODUCTION

The demographic landscape, notably in countries like India, is witnessing a rapid surge in the elderly population, primarily attributed to increased life expectancy. However, this demographic shift brings forth significant challenges, with a notable concern being the prevalence of falls among seniors. Falls can result in severe consequences such as tissue damage, fractures, and head trauma, particularly alarming for those living independently. Compounded by busy schedules and reliance on caregivers, ensuring timely assistance becomes paramount. Consequently, the development of AI-powered fall detection systems emerges as a critical solution to address this pressing issue. These innovative systems leverage advanced algorithms to promptly detect falls and alert caregivers, thereby reducing the risk of prolonged immobility and further complications. By providing timely intervention, these systems play a crucial role in safeguarding the well-being of the elderly, especially considering the escalating likelihood of falls with advancing age. As the aging population continues to grow, the importance of such technologies cannot be overstated, offering a vital lifeline for elderly individuals living independently and their caregivers, ensuring their safety and quality of life.

II. LITERATURE SURVEY

In [1] T. R. Aditya, Sanath S Pai, Karthik Bhat U, P. Manjunath, G. Jagadamba. “Real Time Patient Activity Monitoring and Alert System” in Electronics and Sustainable Communication Systems (ICESC), 2020 International Conference the paper proposes a method to compare, capture, and generate alert messages regarding the patient's condition using the sensors and GSM module. It tries to provide an efficient monitoring system for effective health care services for the patients of ICU.

In [2] Rui Hu, Bruno Michel, Dario Russo, Thomas Brunschwiler. (2020, December) “An Unsupervised Behavioral Modeling and Alerting System Based on Passive Sensing for Elderly Care” in Future Internet 2021 the research likely introduces an innovative system that utilizes passive sensing techniques to develop unsupervised behavioral models for elderly care. By analyzing behavioral patterns and implementing alerting mechanisms, the system aims to enhance the monitoring and support of elderly individuals, offering a non-intrusive and proactive approach to caregiving.

In [3] Sharnil Pandya, Mayur Mistry, Ketan Kotecha, Anirban Sur, Asif Ghanchi, Vedant Patadiya, Kuldeep Limbachiya. (2021, May) “Smart Aging Wellness Sensor Networks: A Near Real-Time Daily Activity Health Monitoring, Anomaly Detection and Alert System” in Second International Conference on Computing, Communications, and Cyber-Security, contribution of the paper lies in the development of the Smart Aging Wellness Sensor Networks (SAWSN) system, which integrates advanced sensor technologies and real-time monitoring capabilities to provide comprehensive daily activity health monitoring, anomaly detection, and alert systems specifically tailored for elderly individuals.

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In [4] Richard Norman Sather III, University of Minnesota, Mahsa Mitcheff, University of Notre Dame, Nabiha Imtiaz, Arshia Khan. (May, 2021) "Assistive Robots Designed for Eldery Care and Caregivers", in International Journal of Robotics and Control 3(1):1, DOI:10.5430/ijrc.v3n1p ,the research explores the potential of these robots to enhance the quality of life for elderly individuals and alleviate the burden on caregivers through innovative robotic technologies and tailored design approaches.

In [5] Márcio Renê Brandão Soussa, Valter de Senna, Valéria Loureiro da Silva, Charles Lima Soare. (March, 2021) "Modeling elderly behavioral patterns in single-person households" in Multimedia Tools and Applications" the study focuses on understanding and analyzing the behavioral patterns of elderly individuals living alone, aiming to provide insights into their daily activities, routines, and potential challenges. By modeling these behavioral patterns, the researchers may seek to develop strategies or interventions to improve the well-being and quality of life of elderly individuals in single-person households.

In [6] Tharushi Kalinga, Chapa Sirithunge, A.G. Buddhika, A.G. Buddhika, Buddhika Jayasekara. (2020, April) "A Fall Detection and Emergency Notification System for Elderly" in 2020 6th International Conference on Control, Automation and Robotics (ICCAR) ,the research likely focuses on the development and implementation of a system capable of detecting falls among elderly individuals and notifying caregivers or emergency services. The system utilizes various technologies such as sensors, machine learning algorithms, or wearable devices to detect falls and ensure timely assistance, thereby enhancing the safety and well-being of elderly individuals.

In [7] Zahra Ferdous, Saadman Sakib, M.M.A. Hashem. (2021, December) "Fall Guardian: An Intelligent Fall Detection and Monitoring System for Elderly" in 5th International Conference on Electrical Information and Communication Technology (EICT) ,this research likely introduces a novel system called "Fall Guardian," designed to intelligently detect and monitor falls among elderly individuals. The system may incorporate advanced technologies such as artificial intelligence, sensor networks, or IoT devices to provide real-time fall detection and monitoring, thereby enhancing the safety and well-being of elderly populations.

In [8] Aniqua Nusrat Zereen, Anubinda Gurung, Amir Rajak, Jednipat Moonrinta, Matthew N. Dailey, Mongkol Ekpanyapong. (2023, April) "Video analytic system for activity profiling, fall detection, and unstable motion detection" in Multimedia Tools and Applications, pages 42395–42415, this research likely presents a video analytic system that utilizes advanced algorithms and techniques for profiling activities, detecting falls, and identifying unstable motions. The system may employ computer vision, machine learning, and motion analysis methods to provide accurate and timely detection of relevant events, aiming to enhance the monitoring and care of individuals, particularly the elderly, in various settings.

In [9] Tiago Ribeiro, Fernando Gonçalves, Inês S. Garcia, António F. Ribeiro, Gil Lopes. (2021, August) "A Collaborative Healthcare and Home Service and Assistant Robot for Elderly Care" in Advances in Industrial Robotics and Intelligent Systems.this research likely introduces a collaborative robot designed to provide healthcare and home services to elderly individuals. The robot may incorporate advanced functionalities such as monitoring health parameters, assisting with daily tasks, and facilitating communication, aiming to improve the quality of life and autonomy of elderly individuals living independently or in assisted living facilities.

In [10] Karthik Kumar Santhanaraj, Ramya M.M., Dinakaran D. (June 2021) "A survey of assistive robots and systems for elderly care" in Journal of Enabling Technologies ISSN: 2398-6263.,the survey likely provides an overview of assistive robots and systems designed specifically for elderly care. The authors may have conducted a comprehensive review of existing literature and technologies in this field, highlighting various types of assistive robots, their functionalities, applications, and challenges.

III. SCOPE AND METHODOLOGY

Aim of the project

The aim of implementing robotic assistance in elderly care is to redefine home caregiving for senior citizens by leveraging deep learning technology specifically tailored for fall detection. The objective is to develop an advanced deep learning model capable of processing video data to swiftly identify instances of a person falling and immediately notify caregivers. By integrating this cutting-edge technology, the goal is to enhance support for the elderly population and ensure their safety at all times. The ultimate objective is to provide a secure environment for seniors by applying deep learning principles to the detection of falls, enabling caregivers to take quick and corrective measures upon detection of such incidents. Through this innovative approach, the project endeavors to revolutionize elderly care, offering timely assistance and protection to individuals living independently.

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Existing system

Most of the existing systems are electronic sensor-based devices whereby older people need to wear them all the time in order to detect the falls. But this can cause discomfort to the elders and most of them don't like to attach anything to their body. And a major disadvantage of the wearable sensor-based system is that the elders may forget to wear these devices and in which case the fall won't be detected. Another commonly used technology is the vision based detection systems. These systems eliminate the need to wear devices on the body all the time.

Proposed system

The proposed system comprises four primary modules: Pre-processing, Model Creation, System Training, and Classification. The Pre-processing module is responsible for resizing dataset images to the required dimensions. In the Model Creation module, a machine learning model with the desired number of layers is constructed.

The System training phase involves training the system with dataset images and storing the model weights. Finally, the Classification module classifies video data for fall detection, triggering an alert notification upon detection of a fall event.

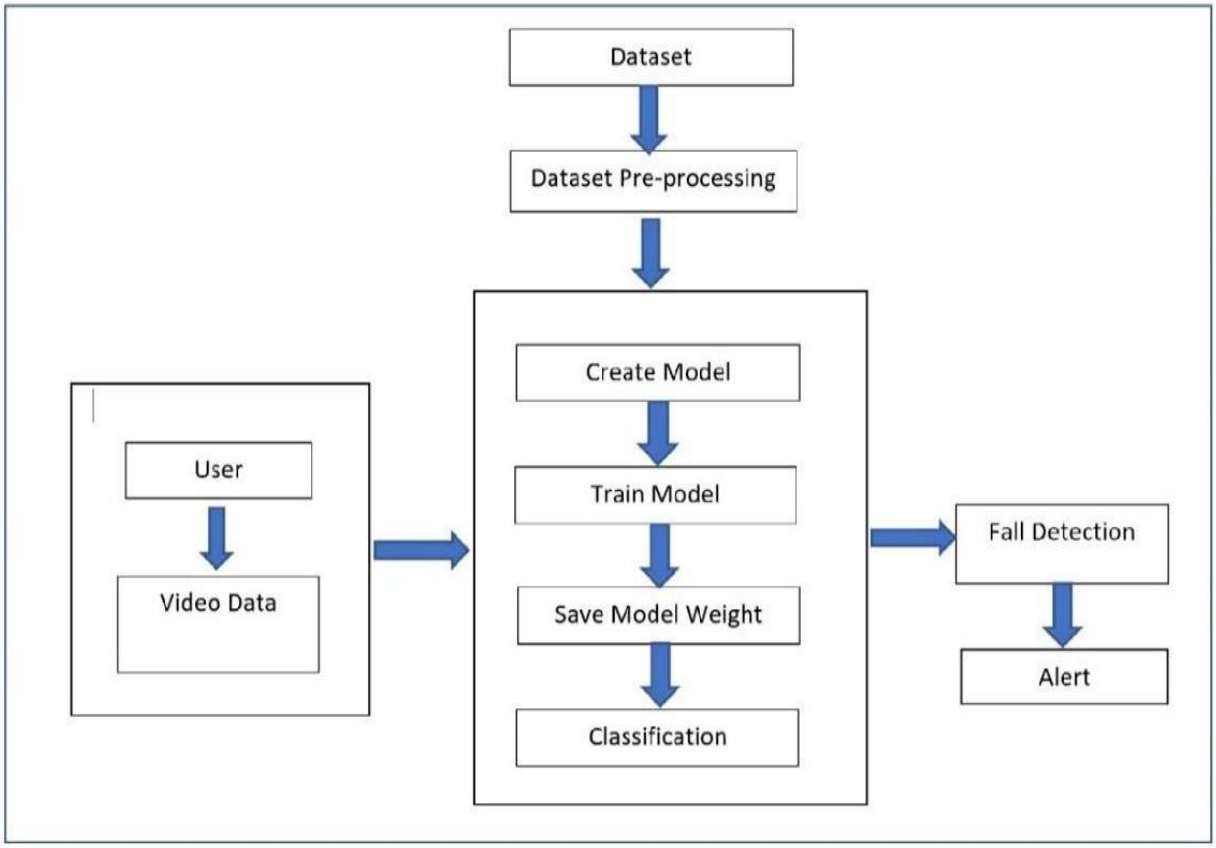

Figure 1. Proposed system

System Architecture

An architectural explanation provides a formal description of a system, organized to facilitate understanding of its structure, the observable properties of individual components, and the interactions among them. This framework supports reasoning about the system's design and facilitates the development of components that work together to implement the system as a cohesive whole.

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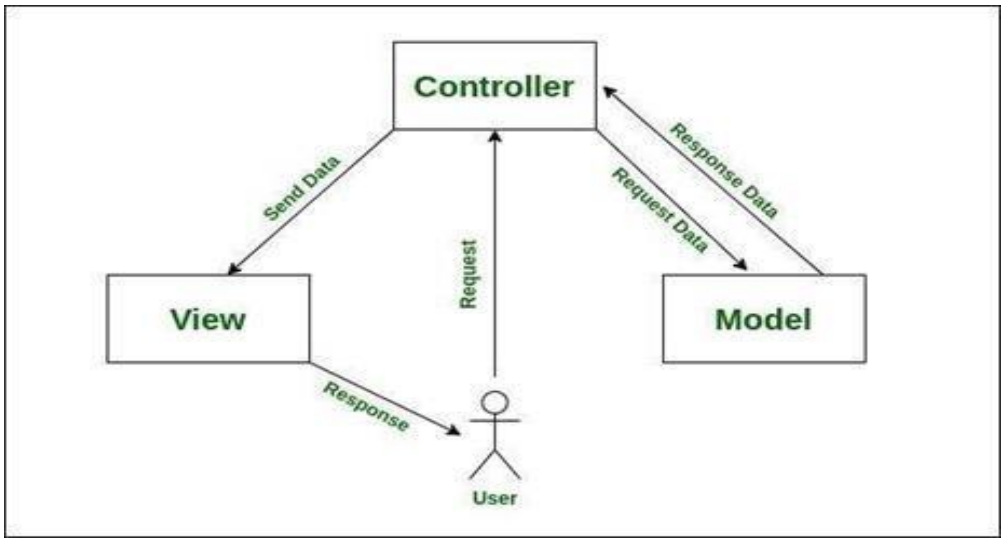

Figure 2. System Architecture

The Model component corresponds to all the data-related logic that the user works with. This can represent either the data that is being transferred between the View and Controller components or any other business logic- related data. The View component is used for all the UI logic of the application. Controllers act as an interface between Model and View components to process all the business logic and incoming requests, manipulate data using the Model component and interact with the Views to render the final output.

IV. RESULTS

The primary objective of testing is to assess the effectiveness and accuracy of the implemented deep learning model for fall detection in robotic assistance for elderly care. The goal is to validate that the model swiftly identifies instances of a person falling in video data and promptly notifies caregivers. Testing aims to ensure that the integration of deep learning technology enhances support for the elderly population and provides a secure environment by enabling quick and corrective measures upon detecting fall incidents.

Figure 4.1. Results

The model successfully detected simulated fall events and promptly generated notifications to caregivers, showcasing its effectiveness in providing timely assistance and ensuring the safety of elderly individuals. These results validate the successful integration of deep learning principles into fall detection for robotic assistance in elderly care, contributing to the goal of revolutionizing caregiving practices for seniors living independently.

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V. CONCLUSION

In conclusion, the development of a deep learning model capable of processing video data to detect instances of a person falling and promptly notifying caregivers holds immense potential. Robotic assistance for elderly care stands as a promising avenue for enhancing the independence and quality of life for seniors. Despite challenges related to acceptance, ethical considerations, and cost, ongoing advancements in robotics technology and tailored design present opportunities to address these concerns effectively. Through proper implementation and integration into existing care frameworks, robotic assistance has the potential to make a substantial impact in supporting aging populations worldwide.

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[1]. T. R. Aditya, Sanath S Pai, Karthik Bhat U, P. Manjunath, G. Jagadamba. “Real Time Patient Activity Monitoring and Alert System” in Electronics and Sustainable Communication Systems (ICESC), 2020 International Conference.

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