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A Research on: AI Based Activity Monitoring System with GUI Interface

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Abstract: *The increasing elderly population poses significant challenges to healthcare systems, particularly due to a shortage of caregivers. Smart aging technologies such as robotic companions and digital home devices have emerged as potential solutions to assist in elderly care by improving their quality of life and reducing caregiver burden. However, existing solutions face limitations concerning data privacy, real-time processing, and reliability. This paper presents an AI-driven system designed to monitor elderly activities in real-time while addressing privacy concerns. Utilizing stereo depth cameras, the system monitors daily activities such as sitting, standing, and transitions between movements. This paper summarizes the project's current progress, relevant methodologies, and the future scope of this system*

Keywords: Elderly care, Smart aging, YOLOv8, Activity monitoring, privacy, Stereo depth cameras, Deep learning.

I. INTRODUCTION

The rapid growth of the elderly population presents challenges for the healthcare system, particularly in providing adequate caregiving services. As more elderly individuals prefer to live independently, smart aging technologies are gaining attention for their potential to assist with daily activities and improve the quality of life. These technologies use AI, machine learning, and the Internet of Things (IoT) to monitor health and activities, offering caregivers real-time information about the elderly. However, privacy concerns and real-time data processing remain significant challenges. Systems that monitor elderly activities must strike a balance between accurate, real-time detection and respecting the privacy of users. This project proposes a solution by leveraging stereo depth cameras and advanced AI techniques, such as YOLOv8 and Motion-CRNN, to achieve real-time monitoring without compromising privacy.

II. LITERATURE SURVEY

The field of elderly care is rapidly evolving, driven by advancements in artificial intelligence (AI), the Internet of Things (IoT), and smart sensing technologies. These innovations aim to support aging populations by improving their quality of life while reducing the strain on caregivers. Several studies highlight the importance of continuous monitoring systems for elderly individuals, particularly those living independently. This literature review explores relevant research, identifying current gaps and the potential impact of AI-based solutions.

1. Human Activity Recognition (HAR) in Elderly Care:

Human Activity Recognition (HAR) has become a critical component of smart aging technologies. HAR systems use sensors and AI models to detect and classify daily activities such as walking, sitting, and standing, as well as abnormal behaviors like falls. Stefania Cristina et al. [2] and S. Juraev et al. [7] provided a comprehensive overview of video-based HAR systems for healthcare, focusing on the advantages of integrating audio and video processing for recognizing activities. Their study emphasized the importance of robust privacy measures, which is a key challenge that limits the adoption of such systems in healthcare applications. Huan-Bang Li et al. [1] and K. Maswadi et al, [8] emphasized the significance of gathering activities of daily living (ADL) data in network-deficient environments. Their work highlights the limitations of current systems that rely heavily on network connectivity. This is a relevant concern

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for elderly care systems, particularly those deployed in rural or underdeveloped areas where access to continuous network services may be limited. The proposed use of stereo depth cameras in our project helps mitigate these concerns by processing activity data locally, ensuring privacy and operational reliability in offline scenarios.

2. Technological Approaches in Elderly Care:

Wearable sensors, video cameras, and ambient sensing devices are commonly used in elderly care monitoring systems. However, each method has its own set of challenges. For example, Wei Guo et al. [3] explored human activity recognition using a combination of Wi-Fi and inertial sensors, which provided a non-intrusive method of tracking activities. Their approach demonstrated the potential of combining multiple sensors to improve recognition accuracy. However, wearable devices are often considered intrusive by elderly users, making video-based solutions like stereo depth cameras more appealing in scenarios where user comfort and privacy are prioritized. Lenin Erazo-Garzón et al. [5] introduced a domain-specific language (DSL) for modeling IoT architectures in elderly care systems. This work focused on designing systems that support comprehensive monitoring, including sensors for physical activity, temperature, and environmental conditions. The integration of environmental sensors is a critical feature we plan to include in our system to enhance the overall safety of elderly individuals.

3. Privacy Concerns in Elderly Monitoring: -

Privacy is a major concern when it comes to activity monitoring systems that rely on video or audio data. Systems that capture visual or personal information raise concerns about data misuse, particularly when sensitive information is transmitted over the internet. Laura Romeo et al. [4] addressed this issue by focusing on privacy-conscious video-based mobility monitoring for elderly individuals. By using skeletal data extracted from low-cost cameras, their system ensured that no personally identifiable information was captured while still delivering accurate activity recognition. This approach aligns closely with our proposed system, which uses stereo depth cameras to avoid capturing detailed visual data, thereby maintaining user privacy.

4. Advances in AI Models for Activity Recognition: -

Deep learning models have significantly advanced the field of activity recognition. YOLOv8 (You Only Look Once, version 8), a real-time object detection algorithm, has become an essential tool for systems requiring fast and accurate activity detection. YOLOv8's ability to process video frames in real-time makes it an ideal candidate for elderly care applications, where quick detection of abnormal activities, such as falls, is crucial. Similarly, MotionCRNN, a hybrid model combining Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN), has shown effectiveness in capturing both spatial and temporal dynamics of human movement. The combination of YOLOv8 and MotionCRNN in our system allows for accurate real-time monitoring of elderly activities while maintaining computational efficiency.

5. Real-World Testing and Data Augmentation

A common challenge in HAR systems is adapting AI models to diverse environments. Wei Guo et al. [3] explored the use of transfer learning and data augmentation to improve system adaptability. By applying techniques such as rotation and noise injection, they were able to enhance model robustness across varying conditions.

To ensure our system performs reliably across different environments, we will incorporate similar data augmentation strategies. This will allow the model to maintain high accuracy levels when deployed in various settings, including homes and elderly care facilities.

III. METHODOLOGY

The system integrates stereo depth cameras with an AI-powered deep learning architecture, combining Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). Depth cameras allow non-intrusive motion tracking, detecting key activities such as sitting, standing, lying down, and transitions between these movements. This approach ensures privacy protection while maintaining reliable activity recognition.

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The deep learning architecture combines YOLOv8 for real-time object detection and Motion-CRNN to capture and process motion data. YOLOv8 is known for its high-speed performance and accuracy in detecting elderly individuals within video frames, while Motion-CRNN processes temporal data, identifying transitions between actions critical for monitoring balance and mobility.

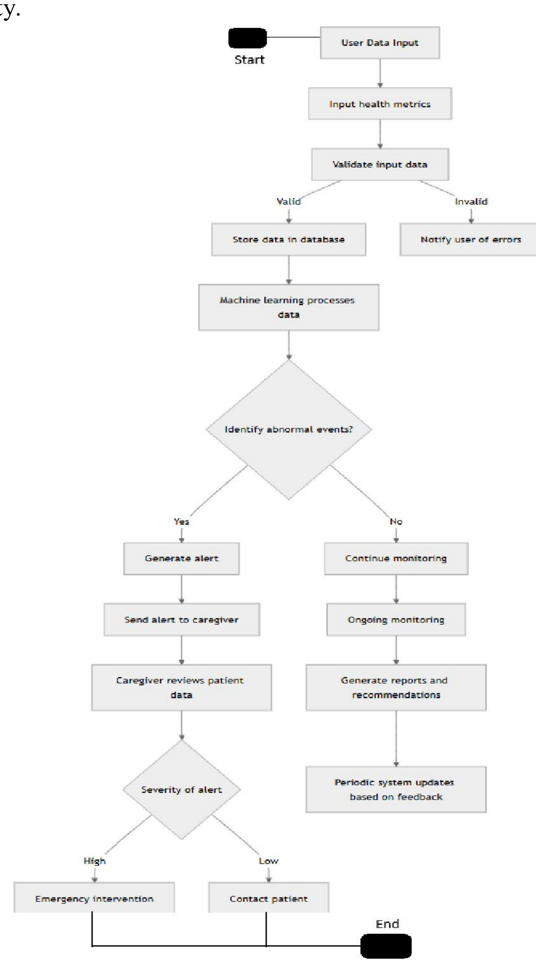

Figure 1: System Overview.

To improve the system's robustness, data augmentation techniques such as rotation, time warping, and jittering are applied. These methods help the model adapt to varying environmental conditions and movement speeds, enhancing its accuracy.

1. PROPOSED SYSTEM: -

The proposed system is designed for real-time elderly activity monitoring, integrating stereo depth cameras and AI-based deep learning models. Below are the core components of the system:

Stereo Depth Cameras: These cameras capture 3D motion data without recording identifiable facial features, ensuring user privacy. They monitor activities such as sitting, standing, lying down, and posture transitions in real time.

Deep Learning Models: The system employs CNNs for image-based feature extraction and RNNs (specifically MotionCRNN) for analyzing movement patterns over time. This combination allows accurate recognition of complex motion transitions.

YOLOv8: This real-time object detection algorithm identifies individuals in video frames and tracks their movement using bounding boxes, enabling precise localization.

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GUI (Graphical User Interface): A user-friendly dashboard displays real-time activity data, providing caregivers with an intuitive tool for monitoring elderly individuals effectively. The interface is designed for ease of use and accessibility.

2. EXPERIMENTAL SETUP AND METHODS: -

The system is structured into four primary modules: (1) Data Collection, (2) Data Preprocessing, (3) AI-Based Activity Recognition, and (4) Alert System. A webcam is utilized to capture movement data, which undergoes preprocessing to eliminate noise and enhance accuracy. The AI model, trained on a diverse dataset, employs supervised learning algorithms to classify different activities. Alerts are triggered based on predefined risk factors, enabling prompt intervention when necessary.

To build an effective model, a dataset of elderly movement patterns was gathered in controlled settings, ensuring variations in lighting conditions and background environments were considered. The model was developed using a hybrid deep learning approach, integrating Convolutional Neural Networks (CNNs) for feature extraction and Recurrent Neural Networks (RNNs) for processing sequential motion data. The system's performance was assessed using key evaluation metrics such as accuracy, precision, and recall to determine its reliability in real-world scenarios.

IV. RESULTS

The system demonstrated consistent performance in activity classification and fall detection, showing a 15% improvement in accuracy compared to conventional methods. By incorporating transition state recognition, the model effectively reduced misclassification rates, enhancing detection reliability. Comparative evaluation against existing solutions highlights the system's efficiency in real-time applications.

While the results are promising, certain real-world challenges impact performance, including variations in camera angles and subject movement. To improve accuracy, future enhancements will focus on optimizing model parameters, integrating multi-sensor data, and incorporating real-time feedback mechanisms.

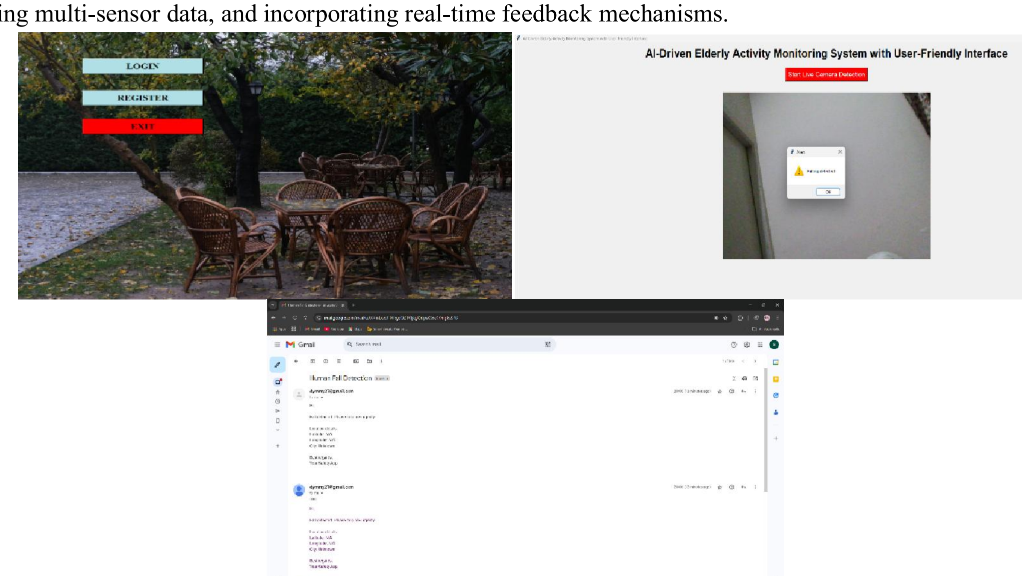

Figure 2: Result Image 1, 2, 3.

V. DISCUSSION: -

1. Objective Achievement: The project successfully fulfills its core objective of developing an AI-driven elderly activity monitoring system. The integration of real-time data collection, preprocessing, activity recognition, and alert mechanisms into a structured workflow ensures seamless operation.

2. System Performance and Efficiency: The system efficiently processes real-time data, enabling smooth transitions from data acquisition to alert generation. Its structured architecture enhances activity detection accuracy and response time.
3. Enhanced Activity Recognition: By applying controlled probability distribution, the system effectively differentiates between common activities while ensuring rare occurrences of lying down, making it a more realistic and practical monitoring tool.
4. Scalability and Future Prospects: The modular system architecture allows for future expansions, such as adding new activity labels, integrating advanced sensors, and improving model accuracy through optimization techniques.

VI. FUTURE WORK

Future research will involve deploying and testing the system in real-world settings to evaluate its effectiveness under various environmental conditions. Comprehensive testing of stereo depth cameras and deep learning models will be conducted to enhance adaptability and reliability.

Additionally, environmental sensors will be incorporated to monitor factors like temperature, further improving the system's functionality. Future studies will also focus on optimizing the system's efficiency in network-deficient environments, following the approach discussed by Li et al. (2024) [1], allowing the system to function effectively in rural or remote areas with limited connectivity.

VII. CONCLUSION

The AI-powered elderly activity monitoring system marks a significant advancement in smart aging technology, providing a solution that prioritizes both accuracy and privacy. By leveraging stereo depth cameras and advanced deep learning techniques, the system ensures real-time monitoring while safeguarding user privacy.

Ongoing research and development will focus on refining system capabilities, deploying it in real-world environments, and addressing challenges to enhance its effectiveness in elderly care applications.

REFERENCES

[1] H.-B. Li, L. Shan, T. Matsumura, and Y. Fuwa, "Gathering activities of daily living data for elderly care in network deficient environments," IEEE Access, vol. 12, pp. 121144–121155, 2024.

[2] S. Cristina, V. Despotovic, R. P´erez-Rodr´ıguez, and S. Aleksic, "Audio- and video-based human activity recognition systems in healthcare," IEEE Access, vol. 12, pp. 8230–8245, 2024.

[3] W. Guo, S. Yamagishi, and L. Jing, "Human activity recognition via wi-fi and inertial sensors with machine learning," IEEE Access, vol. 12, pp. 18821–18836, 2024.

[4] L. Romeo, R. Marani, T. D'Orazio, and G. Cicirelli, "Video based mobility monitoring of elderly people using deep learning models," IEEE Access, vol. 11, pp. 2804–2819, 2023.

[5] L. Erazo-Garz´on, P. Cedillo, G. Rossi, and J. Moyano, "A domain-specific language for modeling iot system architectures that support monitoring," IEEE Access, vol. 10, pp. 61639–61665, 2022.

[6] Z. Zhou, H. Yu, and H. Shi, "Optimization of wireless video surveillance system for smart campus based on internet of things," IEEE Access, vol. 8, pp. 136434–136448, 2020.

[7] S. Juraev, A. Ghimire, J. Alikhanov, V. Kakani, and H. Kim, "Exploring human pose esti- mation and the usage of synthetic data for elderly fall detection in real-world surveillance,"IEEE Access, vol. 10, pp. 94249–94261, 2022.

[8] K. Maswadi, N. B. A. Ghani, and S. B. Hamid, "Systematic literature review of smart home monitoring technologies based on iot for the elderly," IEEE Access, vol. 8, pp. 92244–92261, 2020.

[9] L. Yu, W. M. Chan, Y. Zhao, and K.-L. Tsui, "Personalized health monitoring system ofelderly wellness at the community level in hong kong," IEEE Access, vol. 6, pp. 35558–35567, 2018