Elderly Abnormal Behavior Detection System Using Computer Vision and AI-Based Alerts

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Abstract- This study outlines an AI-supported approach to observing the activity of older adults who may spend periods of time without a caregiver nearby. Video from a camera is analysed with computer-vision methods to recognise selected patterns that could need attention, including a possible fall, an atypical body position, extended inactivity, or a noticeable departure from usual activity. A YOLO-based model is proposed for locating a person and, if the chosen model provides the function, estimating human pose. Rather than treating one image as a confirmed event, a decision stage considers detections across time. If a potentially concerning event is identified, the application stores its time and may notify an authorised caregiver with a short clip or image so that the situation can be checked by a person. The application is intended to assist monitoring and communication; it is not a medical diagnostic system. The paper sets out the need, design, workflow, data requirements, notification process, anticipated outcomes, constraints, and a plan for evaluation. No accuracy or performance figures are stated because these must be established through prototype tests.

Keywords— Elderly care, visual behaviour monitoring, computer vision, YOLO, pose estimation, fall-related events, activity monitoring, caregiver notification, video analysis.

I. INTRODUCTION

As more older people live independently, families need practical ways to remain aware of their safety when they cannot be present throughout the day. A fall, a prolonged period without movement, or a posture that may indicate difficulty can remain unnoticed until a relative or caregiver checks in. Camera footage offers a way to observe a room remotely, but conventional systems generally depend on someone watching the stream or reviewing recordings. This places a continuing burden on caregivers and can delay awareness of an incident.

Computer-vision techniques offer ways to examine images and video automatically. They can locate people, estimate body-joint positions, and follow

movement over successive frames. The YOLO method treats object detection as a prediction task performed by a single neural network and was developed for rapid detection [1]. Current YOLO tools also include pose-estimation models that return keypoints for visible joints, including the shoulders, hips, knees, and ankles [2]. Such outputs may be used as part of a process for highlighting visual activity that deserves a caregiver's attention.

ElderCare AI is proposed as a single application bringing together camera observation, AI-assisted screening of selected events, a record of previous alerts, and caregiver notifications. The goal is to help a caregiver become aware of a possible concern earlier. A person must still review the available evidence and decide what action, if any, is appropriate.

II. PROBLEM STATEMENT

An older person who is alone for part of the day may fall, remain inactive for an unusual length of time, or adopt a posture that warrants checking, without anyone being immediately available to help. Continuous observation by family members is often impractical. Although a basic camera can store footage, it may not recognise a possible event or contact a caregiver when one occurs. A useful system should therefore examine live or recorded video, identify selected visual events for review, retain the related evidence, and inform an authorised caregiver so the situation can be assessed.

III. OBJECTIVES

- Observe an older adult's activity through a camera, with consent and suitable privacy protections.
- Use computer-vision models to locate the person and examine selected body positions or movements.
- Flag possible falls, unusual postures, and inactivity that continues beyond an expected period.
- Apply checks over time and adjustable thresholds to limit warnings caused by isolated or mistaken detections.
- Send a notification to an authorised caregiver when a possible event needs review.
- Keep a dated record of alerts together with the relevant image or video evidence.
- Offer a straightforward dashboard for monitoring, profile information, and reviewing alerts.

IV. EXISTING SYSTEM AND ITS LIMITATIONS

Existing ways of checking on older adults include scheduled visits, telephone calls, wearable help buttons, and standard CCTV. Scheduled visits and calls depend on the caregiver's availability, leaving periods when the person is not directly checked. A wearable button is useful only when the individual is able and remembers to activate it. With ordinary CCTV, someone generally has to watch the live feed or search through recordings to find an incident. These methods can provide support, but they do not necessarily screen video automatically and send an alert together with evidence of the event. The proposed design seeks to address this limitation by analysing video and notifying a caregiver when a selected pattern is detected. It remains a support tool and does not take the place of emergency response, professional medical judgement, or direct care.

V. PROPOSED SYSTEM

The design is organised into five main parts: a camera source, a vision-processing component, an event-assessment component, an evidence and notification component, and a web interface for caregivers. Video frames are passed from the camera to the processing stage. The selected AI model locates the person and, where pose estimation is available, produces posture-related keypoints. The event-assessment stage examines a series of detections over time so that a single prediction is not automatically treated as a real incident.

When the assessment rules indicate a possible event, the application prepares a record with its category, time, confidence or rule details, and a link to the relevant short video or image. A configured notification service can forward a message to the caregiver. The caregiver can then open the dashboard, inspect the supporting material, and decide whether to call or visit the older person.

VI. SYSTEM ARCHITECTURE AND MODULES

Module	Main function	Output
Camera input	Receive a live camera stream or load a recorded video.	Video frames
Pre-processing	Prepare frames by resizing them and selecting the sampling rate.	Model-ready frames
AI vision model	Find the person and, when available, estimate pose keypoints.	Detections and keypoints
Event decision	Check time-based rules, confidence limits, and event duration.	Candidate event
Evidence storage	Store the event time with a short clip or still image.	Event evidence
Notification	Deliver a message to the caregiver through a configured service.	Caregiver message
Web dashboard	Display monitoring state, event records, and older-person information.	Caregiver interface

VII. METHODOLOGY

A. Video Acquisition and Pre-processing

The camera supplies video as a succession of frames. Before model processing, frames can be scaled and selected at an appropriate sampling rate to keep the workload manageable. The application should also respond safely if the camera temporarily disconnects or produces frames of poor quality. Detection results may vary with camera placement, illumination, objects blocking the view, and the arrangement of the room.

B. Person Detection and Pose Analysis

A model from the YOLO family may be applied to identify the person in each frame. When a pose-capable model is used, it can additionally estimate keypoints corresponding to visible joints and body landmarks. The positions of the shoulders, hips, knees, and ankles can then contribute to posture assessment. The YOLO pose guide describes outputs containing keypoint locations along with detection boxes [2]. The implementation must specify the model release and the labels or outputs actually used.

C. Abnormal Event Identification

A person should not be classified as unwell merely because of a facial expression or a prediction from one frame. The proposed approach instead considers visible movement and body-position changes across a defined interval. Test examples may include a quick change from standing to lying down, a fall-like movement followed by remaining on the floor, or a period of inactivity that exceeds a selected time limit. Such patterns only indicate that a caregiver may need to review the situation; they do not establish that an injury or illness has occurred.

D. False-Alert Reduction

The event-assessment stage can limit avoidable alerts by checking whether a pattern continues over several frames, applying confidence limits, filtering out brief posture changes, and enforcing a waiting period before another alert is sent. The caregiver should be able to inspect the related clip before choosing a response. Values for thresholds and time periods should be established using representative tests, not selected without evidence.

E. Alert Generation and History

If an event satisfies the configured rules, the system stores an alert containing the event category, timestamp, and related visual evidence. An integrated service, such as an SMS or messaging gateway, may send the notification to the caregiver's registered contact. The dashboard is intended to show whether monitoring is active, list recent notifications, and allow earlier events to be searched. The messaging provider, API connection, and

deployment arrangement remain to be specified when they are chosen for the implementation.

VIII. DATASET AND MODEL TRAINING CONSIDERATIONS

The training and validation material should reflect the setting in which the camera system is expected to operate. It should cover realistic variation in body shape, clothing, illumination, camera viewpoint, mobility aids, partial obstruction, and everyday movement. Examples of events requiring review should be balanced with ordinary actions that may appear similar, such as deliberately lying down, sitting, bending, resting, or reaching to pick something up. Images and video clips need consistent labels based on a written annotation procedure.

For material obtained from public websites, the licence and permitted conditions of use must be checked before inclusion. Licensed datasets and recordings made with appropriate consent should be preferred where available. Training, validation, and test partitions should be arranged so that nearly identical frames from one video are not spread between the partitions. Once the work is completed, the paper should document the dataset quantity, class balance, annotation process, model version, training configuration, and measured evaluation results.

IX. TECHNOLOGIES AND TOOLS

Technology	Proposed role
Python	Run the AI model and handle video-processing operations.
YOLO-based model	Locate people and provide pose estimates when the chosen model supports them.
OpenCV	Read video, manage frames, and perform image operations.
React	Build the caregiver dashboard, if included in the final application.
Node.js / backend API	Provide application logic, event storage, and communication with the AI component.
Database	Store caregiver and older-person profiles, event times, and alert records.
SMS / messaging API	Send caregiver messages; the service provider is still to be selected.

X. EXPECTED OUTCOMES

The intended deliverable is a working prototype that accepts camera video, detects a person, examines selected posture or movement patterns, creates records for possible events, and displays notifications in a caregiver dashboard. If the messaging connection is configured, the application should also send a message to the registered caregiver and attach a short clip or image to help explain the alert. These describe planned functions; their effectiveness can only be established after testing.

XI. EVALUATION PLAN

Evaluation should use a labelled collection of ordinary activities and possible abnormal events that has been kept separate from the training data. Measures may include precision, recall, F1-score, the number of false notifications per monitoring hour, the proportion of missed events, time taken to raise an alert, and processing throughput. Tests should cover variations in lighting, camera location, partial obstruction, and distance between the person and camera. The time required to deliver a notification and whether the correct clip is linked to each alert should be measured independently. Report each result together with the sample count and test conditions.

Metric	How it will be measured	Measured result
Precision	Number of correctly raised candidate-event alerts divided by all candidate-event alerts.	[To be measured]
Recall	Number of labelled candidate events detected divided by all labelled candidate events.	[To be measured]
F1-score	Harmonic average of precision and recall.	[To be measured]
False alerts	Count of incorrect notifications during each monitoring hour.	[To be measured]
Detection delay	Elapsed time between the event beginning and creation of the alert.	[To be measured]
Inference speed	Video frames handled each second on the evaluation hardware.	[To be measured]

XII. PRIVACY, SAFETY, AND LIMITATIONS

Video observation can expose private information, so the system should operate only with informed consent and proper authorisation. Live streams and saved clips should be available only to approved caregivers. Information should be secured while being transferred and while stored, kept only for a justified period, and removed under a defined retention policy. Camera locations should avoid private spaces and preserve the older person's dignity. Detection may fail or produce an unnecessary warning because of the viewing angle, weak lighting, objects blocking the camera, unexpected movement, or differences between the training examples and the actual environment. An unusual-looking posture may be intentional; conversely, a person may need assistance without displaying a pattern the model can recognise. For these reasons, the application must not be described as a medical diagnostic device or as a substitute for human supervision or emergency services. Caregivers should check each notification and contact the appropriate emergency service when needed.

XIII. CONCLUSION AND FUTURE WORK

This paper has presented a proposed system for supporting elderly care through camera-based vision analysis, review of activity patterns over time, caregiver messaging, and a dashboard containing event records. A YOLO-based model may be used to locate a person and, when a suitable pose model is selected, estimate body keypoints for posture analysis. A separate decision stage examines the sequence of observations and can raise a candidate alert with an associated video extract. The purpose is to improve caregiver awareness, not to identify or diagnose a medical condition.

Further development should include building and checking a dataset collected or used with appropriate consent, evaluating alternative detection and pose-estimation models, refining the analysis of events over time, and measuring the frequency of incorrect alerts. Other work includes implementing secure caregiver access and testing the complete application in realistic indoor settings. The completed project should publish actual measurements and clearly identify the model, dataset, computing hardware, and notification service used.

XIV. REFERENCES

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[2] Ultralytics, “Pose Estimation,” Ultralytics YOLO Documentation. Available: https://docs.ultralytics.com/tasks/pose/ (accessed 14-Nov-2026).

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