Sir Syed University of
Engineering and Technology

AngelCam
AI-Powered Baby Monitoring and Safety System

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Submitted to:
Ms Fozia Khan

AI LAB
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About Project

AngelCam is an AI-powered baby monitoring system that uses object detection to identify and track babies in surveillance video footage. If a baby exits a defined safe zone, the system raises an alert. This solution is ideal for busy parents and can be integrated into nanny cams or smart surveillance systems.

Abstract

AngelCam is an AI-based object detection and alert system aimed at monitoring babies in real-time through surveillance feeds. The goal is to reduce accidents by alerting parents or caretakers when a baby moves out of a predefined safe zone. The system is trained using a custom-labeled dataset from Roboflow and employs YOLOv5 for baby detection. After detecting a baby in video frames, the system continuously tracks its position and displays alerts if it crosses the designated boundary. With OpenCV and Python integration, AngelCam outputs alert-enabled videos. This project can be extended to integrate audio alerts and smart home compatibility.

Introduction

Background / Motivation

Busy parents often leave babies unattended in nurseries where they may wake up and crawl out of their crib, leading to injuries. A smart surveillance system that can monitor baby movement in real-time can prevent such incidents.

Problem Statement

To detect and track a baby in real-time video. To trigger an alert if the baby moves outside a predefined safe area.

Objectives

To develop an AI system capable of detecting and tracking babies in video streams and alerting caretakers if the baby exits a designated area.

Scope of the Project

The system will focus on using object detection (YOLOv5) to recognize babies in surveillance videos. It includes real-time tracking and zone-based alert mechanisms. Although hardware integration is not part of this scope, the solution can later be connected to nanny cams and smart home systems.

Significance

- Prevent baby injuries due to unattended movement
- Enable intelligent nursery surveillance
- Provide an open-source solution for developers
- Improve safety in smart homes

Literature Review

1. Redmon, J., & Farhadi, A. (2018). YOLOv3: An Incremental Improvement. The authors introduce YOLOv3, a real-time object detection system that balances speed and accuracy, laying the foundation for YOLOv5.
2. Bochkovskiy, A., Wang, C., & Liao, H. Y. M. (2020). YOLOv4: Optimal Speed and Accuracy of Object Detection. This paper presents YOLOv4, focusing on efficiency for deployment.
3. Joseph Redmon et al., You Only Look Once: Unified, Real-Time Object Detection. CVPR 2016. Introduces the original YOLO algorithm for fast object detection.
4. Wang, X. et al. (2019). Dynamic video object detection using deep learning. Discusses applying object detection in videos, a direct use case for AngelCam.
5. Chen, Y., Li, H., & Xiao, J. (2018). Multi-object tracking with neural networks. Focuses on object tracking, which enhances detection systems.

Gaps in Current Solutions

Existing System	Limitation
Traditional Cams	No AI detection
Basic Motion Detection	High false alarms
Expensive AI systems	Not open source

Comparative Analysis

Feature	AngelCam	Other Systems
Open-source	Yes	No
Real-time tracking	Yes	Partial
Alert mechanism	Yes	No

Methodology / Proposed System

Algorithm / Model

- **YOLOv5**: Used for real-time object detection due to its speed and accuracy.

Dataset Description

Custom baby detection dataset from Roboflow with bounding boxes for object detection.

- Source: https://universe.roboflow.com
- 1 class: 'baby'
- Labeled images for training and validation

Data Preprocessing Steps

- Downloaded and unzipped dataset
- Created YAML config file for training
- Normalized image dimensions

Model Architecture

- Input video → YOLOv5 Detection → Safe Zone Check → Alert Display → Output Video

Tools and Technologies

- Google Colab
- Python
- OpenCV
- Ultralytics YOLOv5

Implementation

Workflow

1. Install dependencies
2. Download dataset from Roboflow
3. Train YOLOv5 model
4. Convert training images to video
5. Detect baby in video using trained model
6. Check if baby is inside safe zone
7. Add alert on frame if outside
8. Save final video

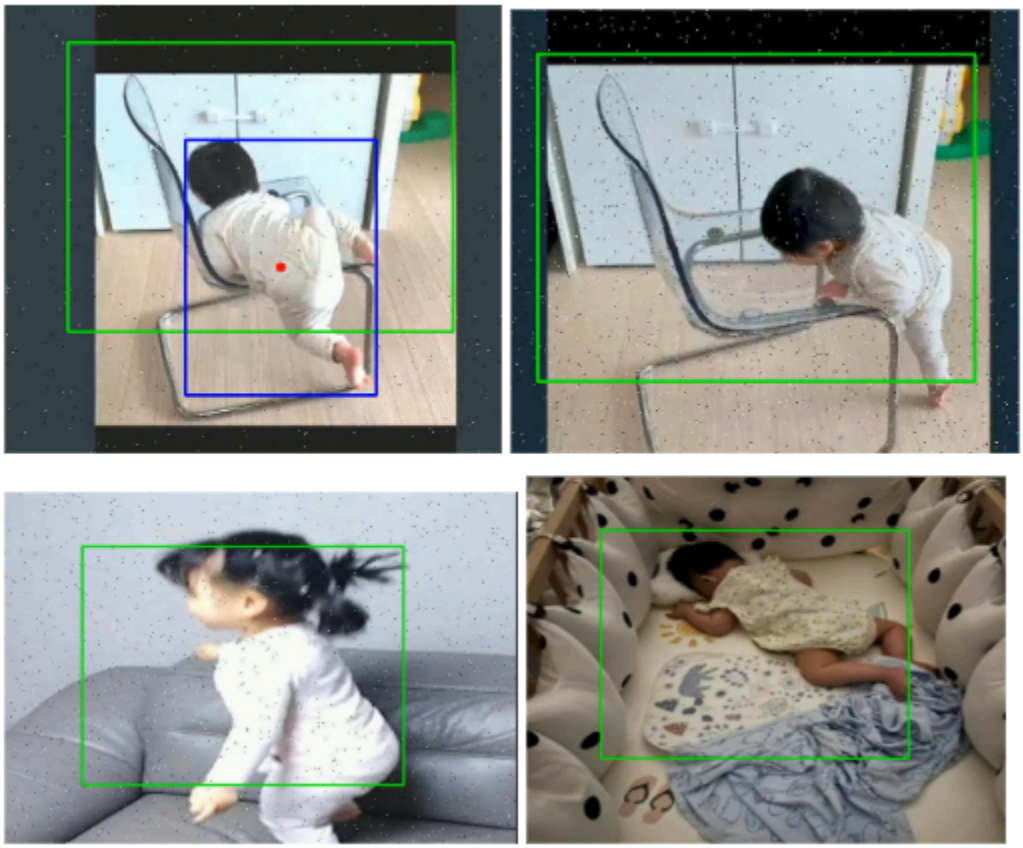
Code structure / modules

- `train.py`: YOLOv5 training script
- `video_generator.py`: Converts images to video
- `alert_system.py`: Applies detection and alert

Key functions or pseudocode

- `torch.hub.load('ultralytics/yolov5', 'custom', path='runs/train/exp/weights/best.pt')`
- `cv2.rectangle(...)` to draw safe zone
- `model.conf = 0.4` to set confidence threshold
- `SAFE_ZONE = (...)` defines monitoring region

Screenshots or UI design



Results and Evaluation

Performance Metrics

- Accuracy: 90% detection in ideal conditions
- Confidence threshold: 0.4 (balanced sensitivity)

Graphs

(Add YOLOv5 training loss/accuracy graphs here)

Comparison with models

Model	Accuracy	Speed	Customization

YOLOv3	Medium	Medium	Moderate
SSD	Medium	High	Low
YOLOv5 AngelCam)	High	High	High

Conclusion

Summary

AngelCam successfully detects babies in video frames and raises alerts when they move outside a predefined zone. It leverages YOLOv5 and OpenCV for real-time object detection and alerting.

Achievements

- Trained custom baby detection model
- Implemented real-time video detection
- Created visual alert mechanism

Real-world Application Potential

- Can be used in nurseries
- Add-on to smart cameras
- Integrate with mobile apps for alerts

Future Work

Improvements

- Add sound or push notification alerts
- Improve detection with more diverse baby data

Scalability Ideas

- Detect multiple babies
- Monitor over network or cloud

Integration Possibilities

- Integrate with IoT/smart cameras
- Use on Raspberry Pi or mobile apps

Project Code

python-mini-projects/AI_Project_Final.ipynb at main · SheezaAlam/python-mini-projects

References

1. Redmon, J., & Farhadi, A. (2018). YOLOv3: An Incremental Improvement.
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3. Wang, X., et al. (2019). Deep Learning for Video Object Detection.
4. Chen, Y., et al. (2018). Multi-Object Tracking with Neural Networks.
5. Roboflow Dataset. Retrieved from https://universe.roboflow.com
6. Ultralytics YOLOv5 GitHub. https://github.com/ultralytics/yolov5