Real Time Image Processing in Security Applications

Digital Image Processing Mini Project Presentation

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Contents Outline

Introduction

Motivation

Real Time Image Processing in Security Applications:

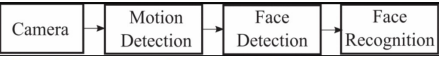
- Retrieving meaningful information from ever increasing data contained in images and analyzing it
- Person and face detection for video surveillance
- Pattern recognition for monitoring
- People and vehicle tracking
- Behaviour Analysis and surveillance in large crowds
- Intruder detection and target recognition,etc.
- Surveillance for security
- Fight against terrorism and crime

Problem Statement

- In this project, we go through three research papers.
- Ultimately we are exploring favourable methods to create a system that can be utilized for overall surveillance.
- In the first paper we go through a relatively traditional method of overall surveillance [1]
- In the next paper, we explore deep learning algorithm for tracking and segmentation. [2]
- In the next paper, we go through an efficient system for Behaviour Analysis.

Human face detection and recognition in videos

Methodlogy



For each frame new background model $B_{t_{(x,y)}}$ is estimated as:

$$B_{t+1_{(x,y)}} = \alpha I_{t_{(x,y)}} + (1-\alpha) B_{t_{(x,y)}}$$

The difference between current frame and background is given by

$$D_{t_{(x,y)}} = \left| I_{t_{(x,y)}} - B_{t_{(x,y)}} \right|$$

I=Current pixel value, t is frame number,(x, y) = pixel location in frame
$\alpha = speedofupdatingbackgroundmodel$, $D = Differenceinframes$

- Background Subtraction: reduces search area
  - Adaptive model: average of frames over time
  - Non-adaptive model : saved frame
- Detect moving object: Background Frame - Current frame .
- Face Detection (if motion detected)
  - Improvised Violas algorithm
  - Applied to subtracted frame
- Face Recognition:
  - Comparing with database images
  - Decompose face into characteristic features-Eigenfaces

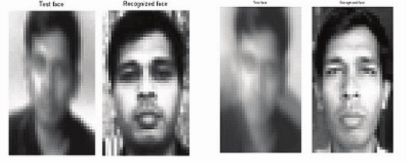
Analysis:

Limitations:

- Fails when person is stationary
- Affected by more than one faces

TABLE I
EVALUATION OVER DIFFERENT VIDEOS

Videos	Frames	Time		Face Detected Frames		Recognition	
		without BS	with BS	without BS	with BS	without BS	with BS
1	237	46.68	99.59	71	74	True	True
2	329	66.69	135.49	99	89	True	True
3	257	135.85	126.02	233	167	True	True
4	339	148.66	162.39	225	167	True	True
5	448	441.136	338.38	305	261	True	False
6	198	73.78	106.55	191	173	False	False
7	78	12.03	33.29	78	63	False	False
8	346	169.4	185.79	238	208	True	True
9	388	204.09	296.47	257	259	True	True
10	237	37.12	99.92	84	57	True	True



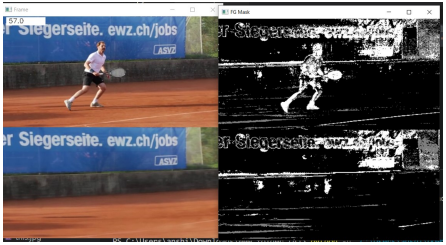
(a) Matching with Background Subtraction

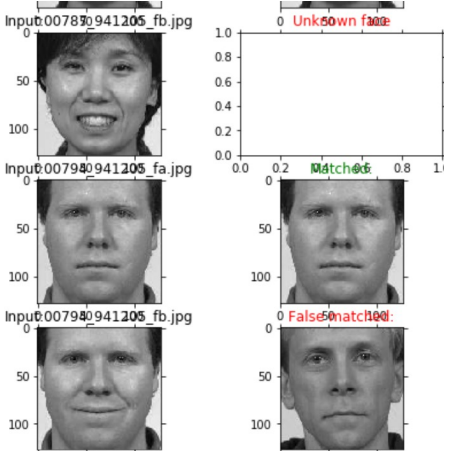
(b) Matching without Background Subtraction

Results:

Links and Datasets:

- Github Link for Paper 1 codes
- Affected by more than one faces

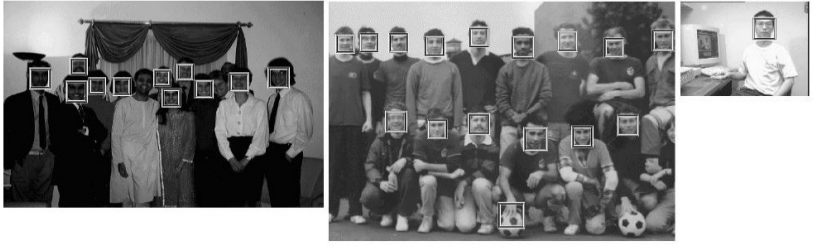




Results:

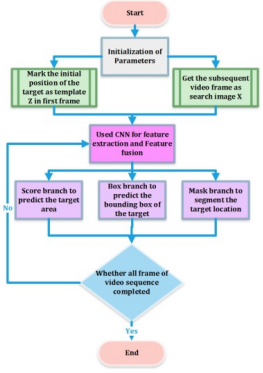
Links and Datasets:

- Github Link for Paper 1 codes
- Affected by more than one faces
- Following Image taken from Viola-Jones paper



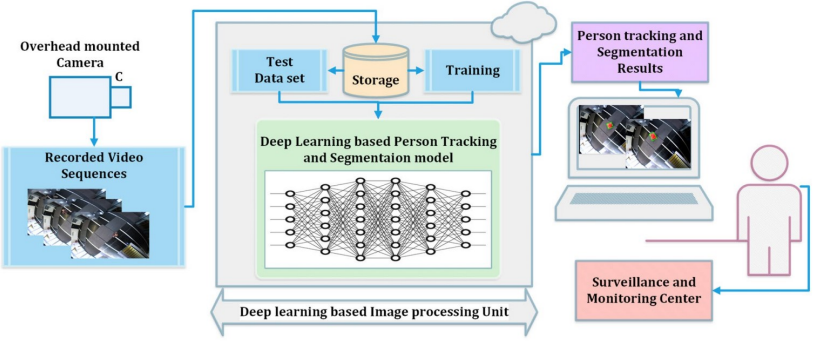
A real-time person tracking system based on SiamMask network for intelligent video surveillance

Introduction



Flow chart of SiamMask algorithm

- Overhead view real-time person tracking and segmentation system.
- Utilizes deep learning algorithm "SiamMask" for real-time tracking and segmentation.
- Intelligent real-time surveillance system integrated with cloud and internet server.
- Performs segmentation of the target person by combining a mask branch to the fully convolutional twin neural network.
- SiamMask tracking accuracy : 95%
- Offline training and online speed method - Improves efficiency.



Real-time person tracking and segmentation system for overhead view surveillance.

Results

visual features of the person's body are diferent from a frontal view; the occlusion problem is reduced, and more coverage of the scene is obtaine

Understanding the algorithm(google collab result)

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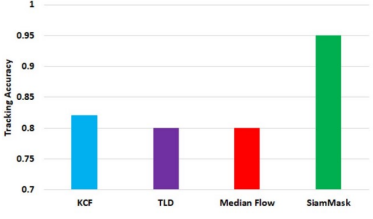
- Github Link
- Datasets Used in paper: DAVIS-2016, DAVIS-2017.

Performance Evaluation and Comparison

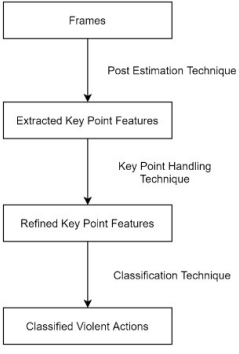


Tracking accuracy of different algorithms and SaimMask

- The paper presents the comparison of SiamMask algorithm with other common surviellance algorithms SiamMask Accuracy : 95%
- KCF: Circular shift the target area to construct a large number of. samples to train the classifier.Use of Kernel function to calculate the similarity between the tracking target and candidate area.
- Median Flow: Enlist the movement of the points on the x-axis and take the median.
- TLD: simultaneously Tracks the object, Learns its appearance and Detects it whenever it appears in the video.

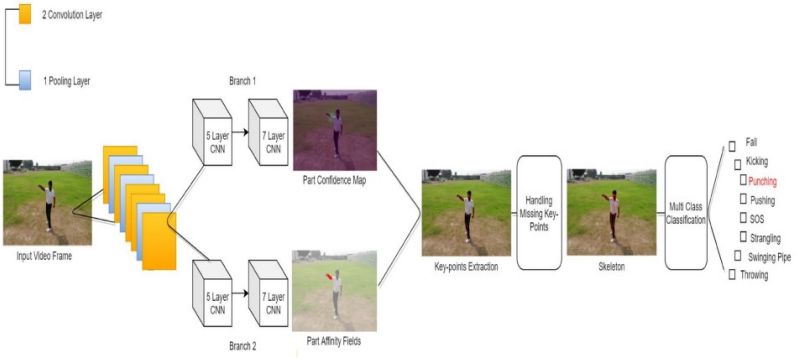
Recognizing human violent action using drone surveillance within real-time proximity

Introduction



Overview of the proposed method

- Efficient autonomous drone surveillance system.
- Can recognize violent actions in public space.
- Classifies eight violent activities (for which model is trained)
- Method:
  - Gets video data from drone
  - Extracts key points from pose estimation algorithm
  - Handles missing key points
  - Classification model identifies violent activity



Detailed description of the method.

Results

Extracted human's key points along with presents the performance of the proposed system on our aerial dataset recorded using a drone (DJI Mavic Pro) which was placed at a height of 2–8 m from the ground.

- Code Withheld
- Datasets: Here.
- Understanding CNN+LTSM approach : Github Link

Performance Evaluation

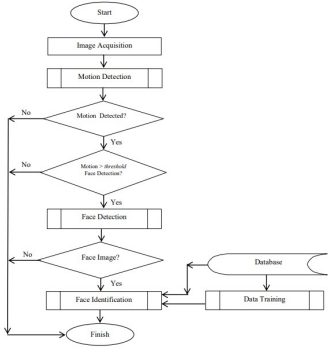
Methods	Accuracy
Proposed method	0.9774
CNN	0.9170
CNN + LSTM	0.9336

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}}.$$

Comparison of the human violent action recognition of the proposed system against the CNN techniques

- TP = true-positive, TN = true-negative, FP = false-positive, FN = false-negative
- CNN: Convolutional Neural Network based algorithm
- CNN+LTSM: CNN Long Term Short Memory

Motion Detection and Face Recognition For CCTV Surveillance System



Design of Motion Detection and Face Identification

- Movement and face detection in CCTVs.
- Motion detection-ADI : 95.655%
- Face Detection- Haar Cascade Classifier: 76%
- Method:
- Data training - CPN algo- 0.0455 MSE with a 94.286% success rate

More Details about the Method

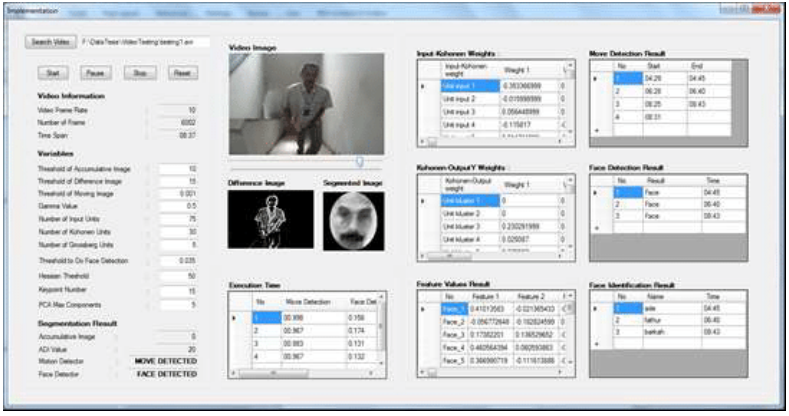
- ADI - Accumulative Differences Images
  - Motion Segmentation
  - Multiple images compared to reference
- Haar Cascade Classifier: ML approach to detect an object[5]
- Face Detection :Speeded-Up Robust Features and Principal Component Analysis

Performance Evaluation and Comparison

Result	Success (%)	Time (second)	
Motion detection	92.655	Time of Detection	1.115
		Process per *frame*	0.02
Face detection	76	0.166	
Face identification	60	0.036	

Result of Motion Detection and Face Recognition

Performance Evaluation and Comparison



Result: The implementation of motion detection and face identification for surveillance system using CCTV video

References

[1]. S. V. Tathe, A. S. Narote and S. P. Narote, "Human face detection and recognition in videos," 2016 *International Conference on Advances in Computing, Communications and Informatics (ICACCI)*, Jaipur, India, 2016, pp. 2200-2205

[2]. Ahmed, I., Jeon, G. A real-time person tracking system based on SiamMask network for intelligent video surveillance.*J Real-Time Image Proc 18*, 1803–1814 (2021).

[3]. Srivastava, A., Badal, T., Garg, A. et al. Recognizing human violent action using drone surveillance within real-time proximity. *J Real-Time Image Proc 18*, 1851–1863 (2021)

[4]. Istiqomah, F. Alam, and A. Rizal, "Best Machine Learning Model For Face Recognition in Home Security Application",*jtim, vol. 4, no. 4, pp. 300-307*, Feb. 2023.

[5]. Viola, P., Jones, M. (2001, December). Rapid object detection using a boosted cascade of simple features. *In Proceedings of the 2001 IEEE computer society conference on computer vision and pattern recognition.* CVPR 2001 (Vol. 1, pp. I-I).

"If you want to promote world peace, go home and love your family"

~Mother Teressa

Thank You!