Hochschule
Bonn-Rhein-Sieg
University of Applied Sciences

b-it Bonn-Aachen International Center for Information Technology

R&D Project Proposal

Comparative evaluation of unsupervised methods for video anomaly detection

Amine Bahlouli

Supervised by

Paul Gerhard Plöger

Santoch Thoduka

Month 20XX

1 Introduction

- .Anomaly detection is an important topic that deals with identification of events that deviate from the usual behavior of data.the classical approach of anomaly detection is for every new data instance an anomaly score is computed then this score is compared to the average data instance and if the difference is bigger than a predefined threshold the data instance is then considered an outlier . and because the development of technology and machine learning algorithms it has now become possible to apply it in video to detect events that do not correspond with the regular behavior. detecting abnormal events is considered a challenging task because of many reasons: (I) the number of possibilities this task might include. (II) the the variability associated with complex environment. (III) it is quite though to distinguish between normal events and abnormal events Video anomaly detection has attracted lots of research recently and several approach have been proposed. the first approach are models that are based on supervised learning, they often require labeling both normal and abnormal events, however this task is time consuming as it requires a massive labeling effort. moreover, it's impracticable to try to label all the normal and abnormal events that exists as it can be endless process, second approach is semi-supervised approach, it requires only labeling the normal event then any event that diverge from the normal event is considered an abnormal event, but it is hard to label all the normal event that are used for training. the third approach is unsupervised learning which does not require any labeling, this type of learning can detect anomalies including the ones that has never seen before

- Such technology ca be used in the field of active recognition, hence can be used in CCTV surveillance cameras to analyze videos frames and detect humans abnormal behaviors that can be considered a threat to environment or other people. other factor CCTV cameras require a great staff and such jobs are often repetitive and abnormal are events are a bit rare. therefore there is a need to automate this process

- Even though visual anomaly detection are often used for surveillance however

it is possible to use them in autonomous robots, for example self-driving car should predict the behavior of humans so that it can adjust its behavior, same applies for robot when it is operating its environment if something goes wrong it can recognizes and stops before thing get worse

1.1 Problem Statement

- The main objective of this research is to conduct a comparative study of unsupervised algorithms applied for video anomaly detection
- The evaluation of the unsupervised algorithm will be on 1 or more benchmark data

2 Related Work

2.1 Supervised Methods

- These methods classify event into normal ad abnormal events based on trained model where a labeled data is fed to the model and the model learn to classify events based on that.there were several supervised learning algorithms proposed.[1] Used Gaussian mixture model trained using expectation maximization to describe probability function of normal behavior pattern.while [2] has focused on constructing a video representation that enables anomaly detection using MRFs, LDA. however these methods might mask the visual representation, that's why representations based on dynamic textures (DTs) was proposed to model the complex scenes.to detect abnormal behavior [3] has used tracked spatio-temporal interest points instead of detection and segmentation, then SVM algorithm was used to find abnormal activities, all well trained supervised algorithms generally produce accurate results however they tend to fail to generalize to new unseen scenarios, as anything that is not included in training phase as normal behavior is considered abnormal

2.2 Unsupervised Methods

- Unsupervised learning extract features from training data without need to label data which makes it an interesting idea for anomaly detection as we need a model that is able to capture unseen situations.[7] tried to model crowd motion using flow motion, under the assumption that people usually escape from a place where abnormal event happens, he proposes an algorithm that detects a divergent centers.[8] partitioned each frame into several grids and in each grid features are extracted and modelled by an Online Weighted Clustering (OWC) algorithm

2.3 Deep Learning Methods

- Deep learning have shown a great performance in computer vision tasks. [4] used 3D convolutional to capture regularities in dataset,[5] has proposed Temporally-coherent Sparse Coding (TSC) which is mapped to sRNN to facilitate parameters optimization and accelerate anomaly detection. [6] used Generative Adversarial Networks (GANs) to learn normality of crowd behavior then at test time they generate motion information and appearance to be compared with the real test frame. however such methods are often use a huge training data and a great computational power to train the model

2.4 Subsection 2

3 Project Plan

3.1 Work Packages

The bare minimum will include the following packages:

WP1 Literature Search

WP2 Experiments

WP3 Project Report

3.2 Milestones

M1 Literature search

M2 Literature search+Understanding the topic

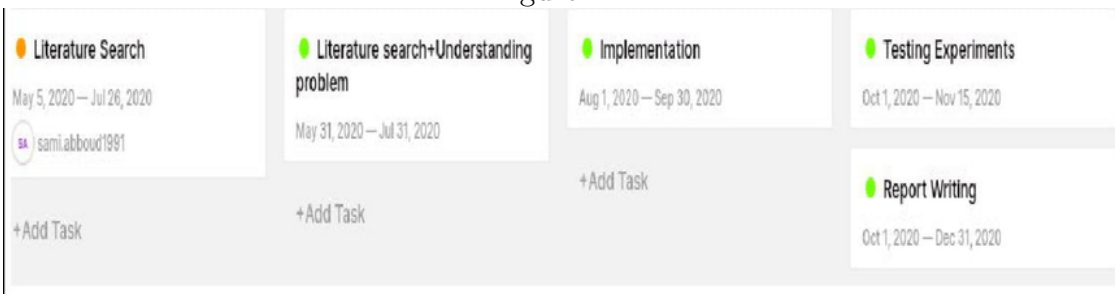
M3 Implementation

M4 Testing Experiments

M5 Report Writing

3.3 Project Schedule

Figure 1:



3.4 Deliverables

Minimum Viable

- Survey
- Analysis of state of the art
- Simple simulated use case

Expected

- Comparison between state of the art algorithms

Desired

- Improving the state of the art

References

[1] Chun-Yu Chen and Yu Shao. Crowd escape behavior detection and localization based on divergent centers. *IEEE Sensors Journal*, 15(4):2431–2439, 2014.

[2] Xinyi Cui, Qingshan Liu, Mingchen Gao, and Dimitris N Metaxas. Abnormal detection using interaction energy potentials. In *CVPR 2011*, pages 3161–3167. IEEE, 2011.

[3] Mahmudul Hasan, Jonghyun Choi, Jan Neumann, Amit K Roy-Chowdhury, and Larry S Davis. Learning temporal regularity in video sequences. In *Proceedings of the IEEE conference on computer vision and pattern recognition*, pages 733–742, 2016.

[4] Weixin Luo, Wen Liu, and Shenghua Gao. A revisit of sparse coding based anomaly detection in stacked rnn framework. In *Proceedings of the IEEE International Conference on Computer Vision*, pages 341–349, 2017.

[5] Ramin Mehran, Alexis Oyama, and Mubarak Shah. Abnormal crowd behavior detection using social force model. In *2009 IEEE Conference on Computer Vision and Pattern Recognition*, pages 935–942. IEEE, 2009.

[6] Mahdyar Ravanbakhsh, Moin Nabi, Enver Sangineto, Lucio Marcenaro, Carlo Regazzoni, and Nicu Sebe. Abnormal event detection in videos using generative adversarial nets. In *2017 IEEE International Conference on Image Processing (ICIP)*, pages 1577–1581. IEEE, 2017.

[7] Shandong Wu, Brian E Moore, and Mubarak Shah. Chaotic invariants of lagrangian particle trajectories for anomaly detection in crowded scenes. In *2010 IEEE Computer Society Conference on Computer Vision and Pattern Recognition*, pages 2054–2060. IEEE, 2010.

[8] Yuan Yuan, Jianwu Fang, and Qi Wang. Online anomaly detection in crowd scenes via structure analysis. *IEEE transactions on cybernetics*, 45(3):548–561, 2014.