IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 3, Issue 2, April 2023
Impact Factor: 7.301

Intelligent Video Surveillance using Deep Learning

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Abstract: *In the current era, the majority of public places such as supermarket, public garden, mall, university campus, etc. are under video surveillance. There is a need to provide essential security and monitor unusual anomaly activities at such places. The major drawback in the traditional approach, that there is a need to perform manual operation for 24 ∗ 7 and also there are possibilities of human errors. This paper focuses on anomaly detection and activity recognition of humans in the videos. The anomaly detection system uses principal component analysis network (PCANet) and Convolutional Neural Network (CNN) to solve the problems of manual operation such as the false alarms, missing of anomalous events and locating the position of an anomaly in the video. The frames wise abnormal event is detected using principal component analysis and Support Vector Machines (SVM) classifier. The location of the abnormality in a frame is detected using Convolutional Neural Network.*

Keywords: Video Surveillance ,Deep Learning, Data Collection, Training The Model, Python, CNN, SVM, Random Forest Tree, Html, AWS, Cloud Technology, Abnormal Activity, Camera, Convert Video To Frame

I. INTRODUCTION

A lot of research has been proposed in the field of video surveillance in terms of object tracking and human behaviour. There are numerous applications of video surveillance in various fields such as crowd surveillance, industrial monitoring, forest fire controlling, traffic surveillance, aerial monitoring, security surveillance, post disaster management etc.

Issues with conventional video surveillance approaches are:

1. Lack of real time video processing,
2. Time consuming,
3. Human error that leads to a false alarm,
4. Maintenance and storage constrain,
5. Inefficient when there is a large crowd.

Manual operation for action recognition is time consuming, tiresome, and inefficient especially over a place where the crowd is dense. There is a need of an automated system which optimizes operational issues and sends alerts to human operators without a time delay. This system should be capable to detect operational errors and generates a notification. The system should be capable to track an abnormal event in each frame and generate a notification of such an event. An object tracking and anomaly detection can be improved by applying machine learning techniques on it.

Machine learning, provides the ability to learn from a trained dataset. The video surveillance application such as abnormal event detection or activity recognition provides better results by using machine learning. For instance, one of the most standard techniques such as CNN has been designed to handle even the three-dimensional data of the video input. For example, CNN can be used to extract the features of an image, classify images etc. CNN can extract the features and patterns in a video faster than traditional image processing techniques. The standard Support Vector Machines technique for abnormal event performs poorly when used independently whereas, when used with classification after converting features using deep learning algorithm it performs far better.

There are numerous events such as music concerts, protests, festivals, sports events, etc where a large crowd is gathered. During such events, there is a need of real time and an intelligent system that can help to detect abnormal activities. The system designed for crowd monitoring at the public spaces like train stations, stadiums, airport terminals,

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theaters should consider crowd density, peak time of traffic in the areas etc. The proper crowd management at public places can help to avoid crowd mismanagement and ensure public safety. Various deep learning algorithms can be employed to analyze the behaviour of the crowd from features like optical flow and the changes of optical flow to predict the chance of occurrence of disaster in the crowd in real time.

1.1 System Overview

The project focuses on human activity recognition in a crowd monitoring system, it recognizes the action of a human and detects anomaly events in real time with the minimum delay. The proposed system uses the CNN model to detect abnormality in the frame. Abnormal activities or events in a video are the occurrences of that are unusual events happens in an irregular behaviour. The solution proposed here is to find the abnormal frames first and then process these abnormal frames to locate the abnormal activity

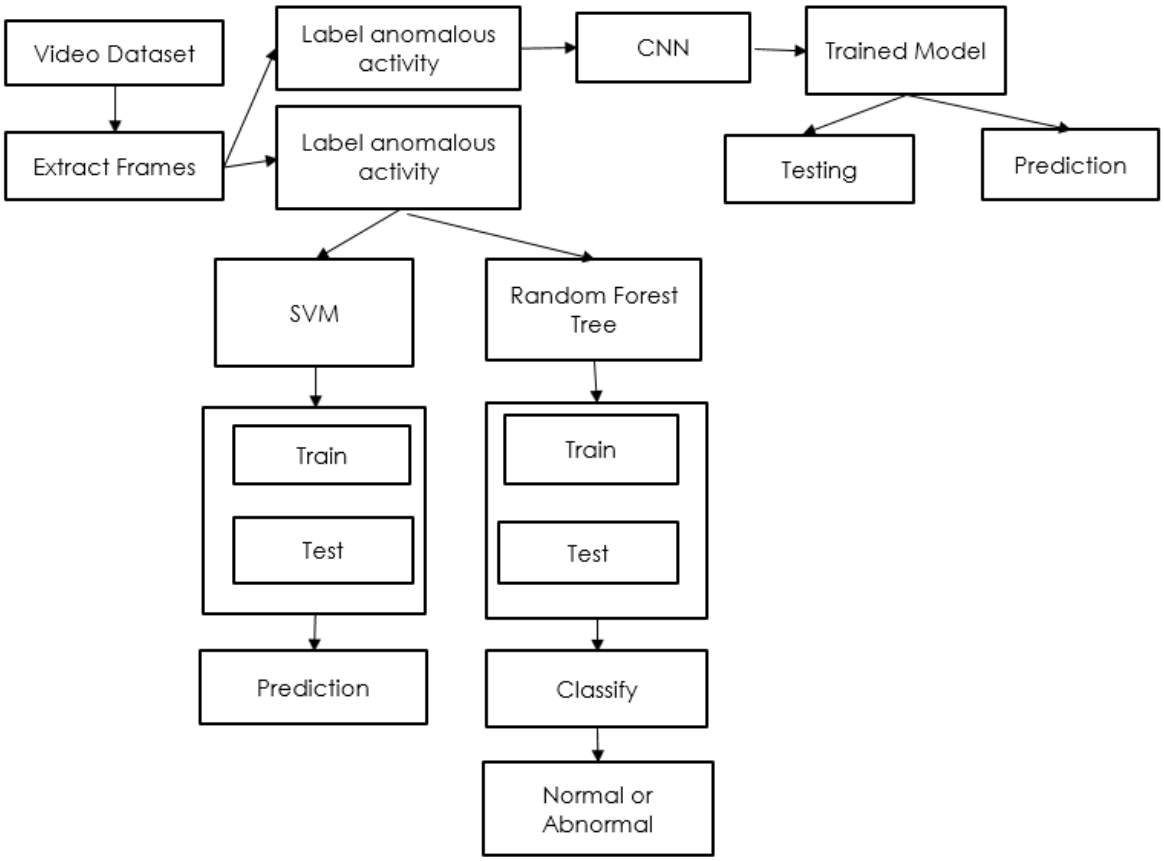

Fig. 1. System Architecture

II. RELATED WORK

In the framework of modeling shape change, a great deal of research has been done on the definition of probability distributions in (Kendall's) shape and preshape space as well as the study of groups of related shapes in the tangent space at the mean. One shape can be transformed into another using affinity deformation, thin plate splines, principal and partial warp deformations, and other models, but none of these explain dynamical models for time sequences of forms.iors and tracking them using a particle-based modeling process: Computer vision study focuses on modeling and identifying actions, human motions, and events. The research can be divided into categories using Bayesian networks (BNs) and DBNs finite-state HMMs for modeling activity stochastic grammars, and factorization technique-based methods. (based on the formalisms used). To learn the statistics of specific things' co-occurrence and relationships with other objects, the authors use clustering.is a different research that classifies events according to their behavioral

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content and treats them like lengthy spatiotemporal objects. The expanded circles of time are used to represent "objects" in motion. HMMs and random methods for activity/event recognition

Our work also defines a parametric model for action performed by a group of objects, in addition to other distinctions. (although it is a continuous-state HMM). We can get our data from low-resolution video or even from other devices like radar, acoustic, or thermal ones because we first think of objects as dots. Second, we provide a single global model for replicating the relationships and independent motion of many moving objects by treating each moving object as a deformable shape.

In computer vision, PFs have been widely used to follow a single moving object while working with a measurement algorithm to gather data. Particle filtering is used in to monitor numerous moving objects, but they each have their own state vectors and data association events that link the state and observation vectors together. In this work, we describe a dynamic model for both shape and motion and use it to represent the combined state of all moving objects using the shape and global motion of their configuration.

III. EXISTING SYSTEM

Crowd surveillance has been the most explored field in recent decades, lots of discussions and research studies have been done. The recent literature targets in the area of crowd surveillance such as anomaly even detection, object tracking, person tagging etc, where machine learning has been applied. The conventional model for crowd behaviour is an agent based model, flow based model and particle based model.

- Less Accurate
- Data analysis is not proper
- Prediction is inaccurate.

IV. PROPOSED SYSTEM

The project focuses on human activity recognition in a crowd monitoring system, it recognizes the action of a human and detects anomaly events in real time with the minimum delay. The proposed system uses the CNN model to detect abnormality in the frame. Abnormal activities or events in a video are the occurrences of that are unusual events happens in an irregular behaviour. The solution proposed here is to find the abnormal frames first and then process these abnormal frames to locate the abnormal activity

V. METHODOLOGY

5.1 Hardware Requirements

The most common set of requirements defined by any operating system or software application is the physical computer resources, also known as hardware. A hardware requirements list is often accompanied by a hardware compatibility list, especially in case of operating systems. The minimal hardware requirements are as follows,

- System – i3 processor
- Speed - 2.4GHZ
- Hard disk - 512GB
- RAM – 8GB

5.2 Software Requirements

Software requirements deal with defining resource requirements and prerequisites that need to be installed on a computer to provide functioning of an application. These requirements need to be installed separately before the software is installed. The minimal software requirements are as follows.

Operating System	Windows 7or later
Simulation Tool	Anaconda (Jupiter notebook)
Documentation	Ms – Office

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5.3 Python

Python is a popular programming language. It is used for web development (server-side), software development, mathematics, system scripting. Python works on different platforms such as Windows, Mac, Linux, Raspberry Pi. It has a simple syntax similar to the English language. Python has syntax that allows developers to write programs with fewer lines than some other programming languages. Python runs on an interpreter system, meaning that code can be executed as soon as it is written. This means that prototyping can be very quick. It can be treated in a procedural way, an object-oriented way or a functional way. Python can be used on a server to create web applications. It can be used alongside software to create workflows. Python can connect to database systems. It can also read and modify files. Python can be used to handle big data and perform complex mathematics. It can be used for rapid prototyping, or for production-ready software development.

Features in Python

There are many features in Python, some of which are discussed below

- Easy to code
- Free and Open Source
- Object-Oriented Language
- GUI Programming Support
- High-Level Language
- Extensible feature

5.4 Jupyter Notebook

The Jupiter Notebook is the original web application for creating and sharing computational documents. It offers a simple, streamlined, document-centric experience Jupyter Notebook tutorial provides basic and advanced concepts of the Jupyter Notebook. Jupyter Notebook tutorial is designed for beginners and professionals. Jupyter Notebook is an open-source, web-based interactive environment, which allows you to create and share documents that contain live code, mathematical equations, graphics, maps, plots, visualisations, and narrative text. It integrates with many programming languages like Python, PHP, R, C#, etc.

5.5 Anaconda

Anaconda distribution comes with over 250 packages automatically installed, and over 7,500 additional open-source packages can be installed from PyPI as well as the conda package and virtual environment manager. It also includes a GUI, Anaconda Navigator, as a graphical alternative to the command line interface (CLI).

The big difference between conda and the pip package manager is in how package dependencies are managed, which is a significant challenge for Python data science and the reason conda exists.

When pip installs a package, it automatically installs any dependent Python packages without checking if these conflict with previously installed packages. It will install a package and any of its dependencies regardless of the state of the existing installation. Because of this, a user with a working installation of, for example, Google Tensorflow, can find that it stops working having used pip to install a different package that requires a different version of the dependent numpy library than the one used by Tensorflow. In some cases, the package may appear to work but produce different results in detail.

In contrast, conda analyses the current environment including everything currently installed, and, together with any version limitations specified (e.g., the user may wish to have Tensorflow version 2,0 or higher), works out how to install a compatible set of dependencies, and shows a warning if this cannot be done.

Opensource packages can be individually installed from the Anaconda repository, Anaconda Cloud (anaconda.org), or the user's own private repository or mirror, using the conda install command. Anaconda, Inc. compiles and builds the packages available in the Anaconda repository itself, and provides binaries for Windows 32/64 bit, Linux 64 bit and MacOS 64-bit. Anything available on PyPI may be installed into a conda environment using pip, and conda will keep track of what it has installed itself and what pip has installed.

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Custom packages can be made using the conda build command, and can be shared with others by uploading them to Anaconda Cloud, PyPI or other repositories.
The default installation of Anaconda2 includes Python 2.7 and Anaconda3 includes Python 3.7. However, it is possible to create new environments that include any version of Python packaged with conda.

5.6 Anaconda Navigator

Anaconda Navigator is a desktop graphical user interface (GUI) included in Anaconda distribution that allows users to launch applications and manage conda packages, environments and channels without using command-line commands. Navigator can search for packages on Anaconda Cloud or in a local Anaconda Repository, install them in an environment, run the packages and update them. It is available for Windows, macOS and Linux.
The following applications are available by default in Navigator:

- JupyterLab
- Jupyter Notebook
- QtConsole
- Spyder
- Glue
- Orange
- RStudio
- Visual Studio Code

VI. IMPLEMENTATION

6.1 Modules

The proposed system consists of the following modules,

- Module 1: Dataset Collection
- Module 2: Pre-processing
- Module 3: CNN Model
- Module 4: Classification
- Module 5: Detection Anomalous activity

6.2 Data Collection and Preprocessing

A dataset (or data set) is a collection of data, usually presented in tabular form. Each column represents a particular variable. Each row corresponds to a given member of the dataset in question. It lists values for each of the variables, such as height and weight of an object. Each value is known as a datum. We have chosen to use a publicly-available patient's data which contains a relatively small number of inputs and cases. The data is arranged in such a way that will allow those trained in disciplines to easily draw parallels between familiar statistical and novel ML techniques. Additionally, the compact dataset enables short computational times on almost all modern computers. Datasets are collected from Kaggle opensource website. That dataset includes patient detail and whose have sleep apnea disease or not. In this step, we use various types of pre-processing techniques to handle the missing, noisy and inconsistent data. There are a number of pre-processing techniques such as case folding dam character erase, tokenization, slang word handling, stop word removal, stemming and number handling. The sklearn pre-processing package provides several common utility functions and transformer classes to change raw feature vectors into a representation that is more suitable for the downstream estimators.

6.3 CNN Model & Classification

The proposed system uses the CNN model to detect abnormality in the frame. The main objective of crowd surveillance is to detect and report any abnormal activities or happenings in the area under monitoring. Abnormal activities or events in a video are the occurrences of that are unusual events happens in an irregular behaviour An efficient video surveillance system should be able to detect and identify an object. An object can be a person as well as group of person

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even the trickier ones like bikes, cars, cats, dogs and packages, etc. These detected objects are further tracked and processed in the consecutive frame. For object recognition, machine learning technique is applied on the training data set. It detects the occurrence of an anomaly event in the scene under observation and it should generate alerts without a time lag. After the model is formed the new set of frames are processed, for abnormal event detection, it is given as an input to the SVM model. The model classifies the images as abnormal or normal frames. Now, to locate the abnormality within the frame. Location of the abnormalities within a frame is detected by CNN. A pre-trained model i.e. represented by model I can be retrained with the dataset of abnormal event detection to form a new model.

6.4 Detection Anomalous Activity

Action recognition, about 100 images from Google image search results were tested in addition to the subframes detected from the anomaly detection system. The proposed action recognition algorithm as mention in Section III, detect an anomaly action is compared with CNN (framewise classification) and Multilayer Perceptron's (MLP) in terms of Top 1 accuracy and Top 5 accuracy, as shown in the Table II. It is observed that the proposed approach performs better and gives Top 5 accuracy of 94%.

VII. CONCLUSION

The growing demand for a secure and safe environment has enhanced the research for developing smart automated surveillance systems. These systems are expected to be adaptable, dynamic, reliable as well as affordable. The proposed anomaly and activities recognition system automatically detects anomaly events and notifies with a tag. The action recognition system implemented classifies the actions of a person in the video with an accuracy of Top 1% accuracy of 71% and Top 5% accuracy of 94%. Also, the proposed algorithm is evaluated in terms of accuracy with three datasets: Avenue, UCSD and UMN, it is observed that proposed approach performs better in Avenue dataset as compare to other two.

ACKNOWLEDGEMENT

We sincerely express our gratitude in depth to our esteemed Founder Chairman & Chancellor Dr. T. R. Paarivendhar, Thiru. Ravi Pachamoothoo Chairman, Mrs. Padmapriya Ravi Vice Chairman, Ms. R. Harini Correspondent, SRM VALLIAMMAI ENGINEERING COLLEGE for the patronage on our welfare rooted in the academic year.

We express our sincere gratitude to our respected Director Dr. B. Chidhambararajan, M.E., Ph.D., for his constant encouragement, which has been our motivation to strive towards excellence.

We thank our sincere Principal Dr. M. Murugan, M.E., Ph.D., for his constant encouragement, which has been our motivation to strive towards excellence.

We extend our hand of thanks to our Head of the Department, Dr. B. Vanathi, M.E., Ph.D., Professor for her unstinted support.

We are thankful to our project coordinator, Mrs. G. Sangeetha, B.E., M.E. for providing us with the essential facilities.

We are grateful to our internal guide Ms.S.SHANTHI, M.E. Assistant Professor without whose invaluable guidance and encouragement, this project would not have been a success.

We also like to thank all Teaching and non-teaching staff members of our department, for their support during the course of the project. We finally thank our friends and family for their support during the course of the project.

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