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Smart Surveillance System using Machine Learning

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ABSTRACT—The current concept of smart cities is influencing city planners and researchers to provide modern, safe and sustainable infrastructure and provide residents with a decent quality of life. To meet this need, video surveillance cameras have been deployed to improve the safety and well-being of citizens. Despite the technological developments of modern science, it is difficult to detect anomalous events in surveillance video systems and requires a great deal of human effort. Security cameras are one of the most common devices that use motion detection technology. In this paper, we suggest a smart surveillance system that enables us to see the movement around an object or a visual area, recognize famous faces, detect objects in real-time as well as track visitors entering a frame.

Keywords—security surveillance, CCTV, face detection, machine learning, openCV, YOLOv4, Convolution Neural Networks

I. INTRODUCTION

Today, security and protection are the greatest challenges in a highly modernized society to prevent the misuse of human life and its valuable assets. In conclusion, protection and protection enhances an individual's social security to protect their personal information, valuable business, and daily activities. Due to the rapid development in the areas of security and assurance, CCTV has played a major role in these objectives. Today, most locations are monitored by video cameras, and CCTV plays a major role in identifying individuals and maintaining systematic behavior in many work areas. Smart CCTV goes one step further than CCTV, which is more secure by offering a large number of advanced applications. The modern mindset of smart cities influences urban planners and researchers to provide the latest safe and sustainable infrastructure and enable citizens to lead quality lives. To meet this need, video surveillance cameras have been deployed to improve the safety and welfare of the population. The largest security system to date on our market is the video surveillance or alert system. You can use CNN algorithms to improve security levels, facial reputation, and object detection strategies. This gives owners access to a wider range of monitoring capabilities. The proposed machine detects the object and identifies the anomalous interest near the door by making use of a Convolutional Neural network. Whilst a stranger attempts to get right of entry to the door, the owner might be capable of managing the door locking device later after looking into the picture of the individual that has been saved in the recordings.

II. LITERATURE SURVEY

A. LBPH Algorithm for Frontal and Side Profile Face Recognition on GPU

The authors of this IEEE published paper tried to convey that frontal face and side profile face recognition using LBPH algorithm are implemented on GPU. In LBP, part of the grayscale image is first taken as a 3x3 window size, the neighboring pixel values are compared to the central pixel value, then a binary value is assigned and it is converted to a decimal value. increase. Second, LBP is called the LBPH algorithm because it is combined with a histogram.

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B. CNN Based Smart Surveillance System

The authors of this paper, took the footage recorded by CCTVs to be used to identify suspects on screen. Initially, the criminal photo is recognized by the system and stored in the datacenter. The CNN method first uses a face detection algorithm to detect a face in the video and then checks to see if that face is present in the data center. It then automatically detects features, extracts features, and provides face recognition from inputs captured by the camera or video. By training the system with a limited number of facial images, it is possible to recognize faces in a variety of natural conditions[4], [5], [7] Their system has also been tested in the context of the Covid 19 post, where masks are required to be worn in public places, so facial recognition has also been tested on these aspects with promising results.

C. Smart CCTV Surveillance System for Intrusion Detection with Live Streaming

In this paper the authors propose to provide a Smart CCTV Surveillance system with intrusion detection. This system performs face recognition as an authentication procedure and alerts the owner when an unknown face is detected. Multiple USB cameras are installed in different locations for live streaming and surveillance purposes. The system performs facial recognition as an authentication method and notifies the owner when an unknown face is detected by sending an email containing an unknown face snapshot and SMS. Live feeds from multiple cameras can be viewed via your smartphone or computer.

D. Anomaly Detection using Edge Computing in Video Computing

In this paper, we surveyed various methodologies developed to detect anomalies in intelligent video surveillance. First, use the anomaly detection survey for the last 10 years. The following is a systematic classification of methods designed to be easy to understand. Because the concept of anomalies is context-sensitive, anomaly detection distinguishes between the various objects of interest and the exposed dataset. Since anomaly detection is considered a time-sensitive application for computer vision, their focus was on anomaly detection with edge devices and a dedicated approach.

E. Smart Surveillance System using Deep Learning

The module is based on a neural network that uses deep learning techniques. The description of their work is as follows. First, the architectural design of the convolutional neural network was presented and analyzed in the context of four selected architectures (two of which were recently successful types) and two custom changes made specifically for the problem at hand. Will be done. The results are carefully evaluated and the best one is selected for use in the proposed system. In addition, the system is implemented on both PCs (with Linux operating system) and smartphones (with Android).

III. SYSTEM ARCHITECTURE

Intelligent video surveillance devices use a three-tier architecture that includes a client aspect, a service server, and a database server. The service server consists of a server device prepared with a GSM modem. Customer facet tools want the browser to be the most effective.

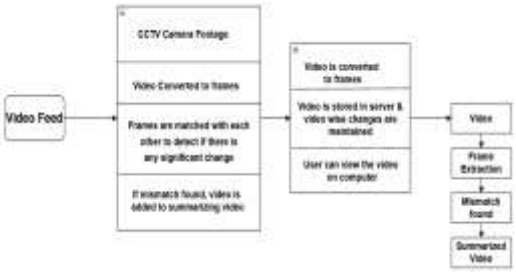

fig. 1 System Architecture Diagram

Connect to the server using the IP address and port number. The server-side device contains two main modules. One is the HTTP server and the other is image processing. The two devices communicate with each other via the http protocol. Therefore, you need an HTTP server. It is created on the server-side device itself. Its main function is to handle pending requests, verify validation and generate a response. The image processing module needs to detect intrusions.

IV. IMPLEMENTATION AND INITIAL RESULTS

The developed system is implemented in a Windows 10 operating system and written in Python, JavaScript with a bunch of machine learning algorithms. If a desktop version of Windows is used, it can support Intel x86, AMD64, and ARM architectures. For system requirements, a system consisting of minimum 4 GB RAM, 256 GB SSD works fine. The working of the system is divided into finding celebrities, finding missing persons/ objects and also noise detection in the frame. Each of the above subsections has a separate workflow and is described as follows:

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A. Identify the Family Member feature :

This feature of face detection [3], is a very useful feature of our project. Used to see if a person is known in the frame. Cascade classifiers that act on hair-like features, or boosted classifier cascades, are a special case of ensemble learning called boosting. It usually relies on the Adaboost classifier (and other models such as Real Adaboost, Gentle Adaboost, and Logitboost). Cascade classifiers are trained with hundreds of sample images of images with and without detected objects.

B. Monitor Feature :

This feature is used to find out what was stolen from the frame displayed on the webcam. You can use the structural similarity to find the difference between the two frames. The two frames are first captured when there is no noise, and then when the noise in the frame stops. SSIM is used as a metric to measure the similarity between two specific images.

C. Visitors in-room detection :

It is a function that can detect whether someone has entered or exited the room. Therefore, it works with the following steps: First, check for movement and find out which side this is coming from, either left or right. If you check the movement from the left edge to the right edge, it will be recognized as input and the image will be captured. Therefore, to know which side the movement came from, we first detect the movement and later draw a rectangle over the noise. The final step is to check the coordinates of the point on the left. Then it is classified as a left movement.

D. Object Recognition :

This feature recognizes objects in real-time using the YOLOv4 algorithm. Running YOLO v4 on a webcam captured image is very easy. I used the code from the Google Colab code snippet. This snippet contains a variety of useful code functions for performing different tasks. I used the CameraCapture code snippet to execute JavaScript code and capture the computer's webcam. The code snippet takes a picture of the webcam and passes it to the YOLO v4 model for object detection. Running YOLO v4 on a webcam video is a bit more complicated than an image. You need to start the video stream using the webcam as input. Then pass each frame through the YOLO v4 model to create an overlay image that includes a bounding box with detection. Then overlay the image in the bounding box on the next frame of the video stream. YOLOv4 is so fast that it can perform detection in real time.

V. EXPERIMENTAL RESULTS

The datasets used are face recognition, taken by using python and web scraping technique. A chrome extension called “Fatkun” could also be used for downloading images in huge chunks. In this, we first, clean and train the dataset. We then preprocessed the dataset and converted it into gray images and then in wavelet format, so that it is easier for the model to make better predictions.

The below Table 1, takes 3 estimators to do the classification and feature extraction technique. A total of 3 algorithms were tried: SVM, Random forest and logistic regression. The best score was made by SVM and thus was chosen.

Table 1. Accuracy Comparison

Sr. No	Model	Accuracy
1	SVM	72.963
2	Random Forest	58.9947
3	Logistic Regression	70.7937

For the object detection part, a pre-trained dataset was used with the help of darknet framework which was of 200 MB. Following are the results.

fig. 2 Training the dataset

In fig 2 First, the dataset is cleaned and trained. It is then preprocessed, converted into gray images and then into wavelet format so that it is easier for the model to make better predictions.

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fig. 3 User Interface of the System

Above fig. 3 is the user interface of the homepage, which has five functions in it: real-time object detection, motion detection in a specific region, visitors in and out tracking, and saving recorded footage.

fig. 4 Face recognition using SVM

Figure 4 shows a total of 5 famous people's datasets taken and classified. It has a probability score accurate up to 95%. The SVM classifier was used for this purpose of face recognition.

fig. 5 Movement Detection

Figure 5 shows the motion/ movement detection. Initially, when the frame is steady i.e when there is no movement going on in the frame it simply displays "NO-MOTION". Later, if there is any movement or disturbance visible in the frame it detects motion and displays "MOTION".

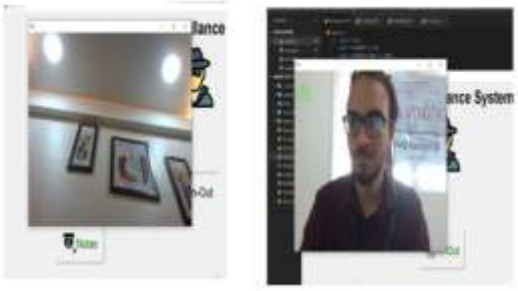

fig. 6. Visitors In-out Detection

Figure 6 detects if a person has entered the frame or not. If it has, then it displays "IN" else no alerts are shown.

fig. 7. Real-Time Object Detection using YOLOv4

Figure 7 shows the output for real-time object detection using the YOLOv4 algorithm. It starts up a video stream which is fed as an input to the YOLOv4 model, which detects 80 different trained objects.

VI. CONCLUSION

The purpose of this research was to recognize faces, detect objects in real-time, capture motion in the selected regions and in the whole frame and save those as well. The scope of this project is to minimize theft happening in future and maximize the protection of data in the highly confidential region. Monitoring can be categorized into individuals, crowds, motor vehicle traffic, human-object interactions, objects or events in general Covid19 situations, and system accuracy if masks need to be worn in public spaces. Is also checked. This system can also be used to search for new missing persons. You can also identify the suspect and save it in your data center. This data center will later be used to identify suspects in public places, allowing for faster trials.

VII. FUTURE WORK

In the future, the cloud architecture will allow you to connect a large number of cameras to this system to build a large network of this system and check the accuracy and speed of tracking

criminals anytime, anywhere. This project uses a smart security camera to unknowingly recognize facial features of a person. This project will be more useful in the industrial and secret fields and will give the right people access to and access to very safe issues. In the future, the cloud architecture will allow you to connect a large number of cameras to this system to build a large network of this system and check the accuracy and speed of criminal tracking anytime, anywhere.

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