SUMMARIZATION OF CCTV VIDEOS USING KNN CLASSIFIER

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ABSTRACT

In this modern era, surveillance cameras are omnipresent. Be it home, office, malls, highway, CCTV cameras are found everywhere monitoring the day to day activities. Surveillance is an important task. They aid in detecting any fishy activity and act as valuable proof. However, the amount of video footage recorded is enormous. Most of the times the useful information contained in it is very less. It becomes a very difficult task to go through so many hours of footage to find the useful content. Storing the videos also takes a huge amount of space. Thus, a need for surveillance solutions is recognized that can condense such long footage into short videos while still retaining important events. Our model can summarize hours of footage shot by CCTV cameras into a short clip that shows all interesting events simultaneously. All moving objects that are present in the video are identified and tracked by our program. These events are then overlaid on a single clip, while also displaying the timestamps for each event, thus letting the user perform surveillance for multiple events. Our model uses KNN classifier for extracting and subtracting background from videos and a custom Object Tracking algorithm to detect moving objects, which is then overlapped on extracted background.

Keywords: ***Video Summarization, Retain important events, KNN Classifier, Object Tracking***

I. INTRODUCTION

Safety and security are an important part of everyone's life. Recent increase in crime and theft at home and workplace has led to various technological advances in this field. Being vigilant is very necessary to be more secure. Due to hectic schedules, it may not be possible to be present at home and office all the time to watch and control the surroundings. Our project is aimed at developing a model which helps in summarization of CCTV videos. It helps in abridging the gap between long footage into short videos while still retaining important events. The same can be applied to any lengthy video for which a succinct version is required where the entire content can be narrowed down to only those part with dynamic frames.

Many researchers have presented various summarization techniques/ Background Subtraction methods over time. Every approach is based on a common concept, the first frame or previous frame is used to generate a background reference model. The object in the foreground is detected by comparing the current frames with the generated background model and then the model is updated. Various background modeling techniques are classified into different categories such as region based, pixel based and hybrid methods. An approach can be either parametric or non-parametric.

The proposed model performs non-parametric background subtraction using KNN classifier and use customized object tracking algorithm for associating bounding boxes across multiple frames.

II. METHODOLOGY

The model starts by collecting various long input videos, CCTV footages shot with static background. The input video undergoes a series of pre-processing and image processing steps. The video is finally condensed to a short clip and written to a recap file which is then available to the user to view.

Our model consists of the following modules:

Background Extraction:

The background is approximated by finding the average of multiple motion frames of the video. Disturbances don't last for a long time throughout the video's duration thus, only the background's pixel values are captured in the final average.

Background Subtraction:

KNN-based background subtraction is used to observe movement or disturbance in the video. Contours are used to fetch bounding boxes for each item on the background.

Object Tracking:

A custom Object Tracking algorithm groups these bounding boxes into individual moving objects. The object tracking algorithm is used to track an object once its initial presence and movement is detected.

Cropping and overlaying moving objects:

The output is refined by making use of certain useful filters. These detected objects are then cropped out of the original video and placed on the background to showcase a merged simultaneous effect.

III. MODELING AND ANALYSIS

The initial analysis consisted of choosing suitable algorithm for classification. The Literature Survey pointed towards various algorithms. After running different algorithms against certain input samples, following observations were made. MOG and KNN provided most suitable output and KNN performed comparatively better.

	MOG	KNN
Erosion	Reduced Noise	Reduced Noise
Dilation	Static frames have reduced yet visible distortion.	Gives better results.
Foreground object	Extra pixels are added to fill in any holes in the foreground object due to which details are hardly visible post dilation.	Compared to results of MOG, details are much clearly visible.
Video taken by a moving camera	For videos with rapidly changing background, MOG provides mediocre results.	KNN provides good results even when the background changes continuously.

Table 1: Comparison between Mixture of Gaussian and K-Nearest Neighbors

Figure 1: System Design Model.

To the input video KNN-based background subtraction is applied. KNN is said to be a lazy learner where training dataset are stored, and querying similarity is assigned between test data and training set records which are to be calculated. This helps predict the class of test data. The class is represented by the majority label k-nearest neighbours in the training data set. A moving average of all frames in the video is applied to approximate the background. The background average is free from disturbances and tries to depict the background as accurately as possible. Contours help to get bounding boxes for each item on the background. The foreground mask performs a subtraction between the current frame and a background model, containing the static part of the scene. The Object Tracking algorithm associates the bounding boxes into individual moving objects. The model iterates over each frame and for every bounding-box found, it finds the nearest, already

existing moving object. If the object and the box turn out to be the entities with maximum proximity, they are associated into the same moving object. If the box is alone, it becomes a new moving object. If object is alone for quite some frames, that object is not tracked further. The output is enhanced and fine-tuned by applying filters. These objects are then cropped out of the original video and overlaid on the background simultaneously. Time of occurrence of the events is also displayed next to the moving object. One issue that was faced was the overlap of multiple event objects. Providing mild transparency to events proved to be an effective solution. The python code applies the forementioned steps to the input video provided by user. The summarized video is written to output file and stored which can be viewed by user.

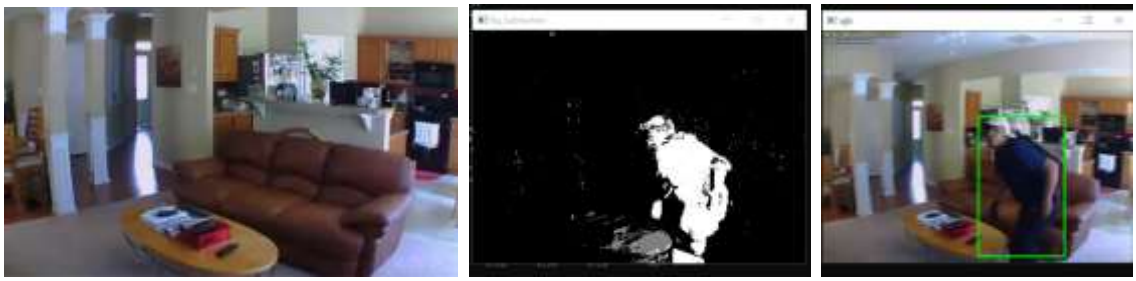


Figure 2: Representational analysis of background extraction, background subtraction and object tracking.

IV. RESULTS

This model successfully generates summarized video output for given input video and stores it. Time stamps are also shown for effective tracking and surveillance. Video clarity and resolution was retained up to 90% making the output comfortable to view. The KNN classifier reported an accuracy of 97.77%.

Every user class will have a common benefit from using our product viz. reduced storage requirement to store surveillance footage, faster analysis of events occurring in the footage, saving time, and thus gaining an increase in efficiency.

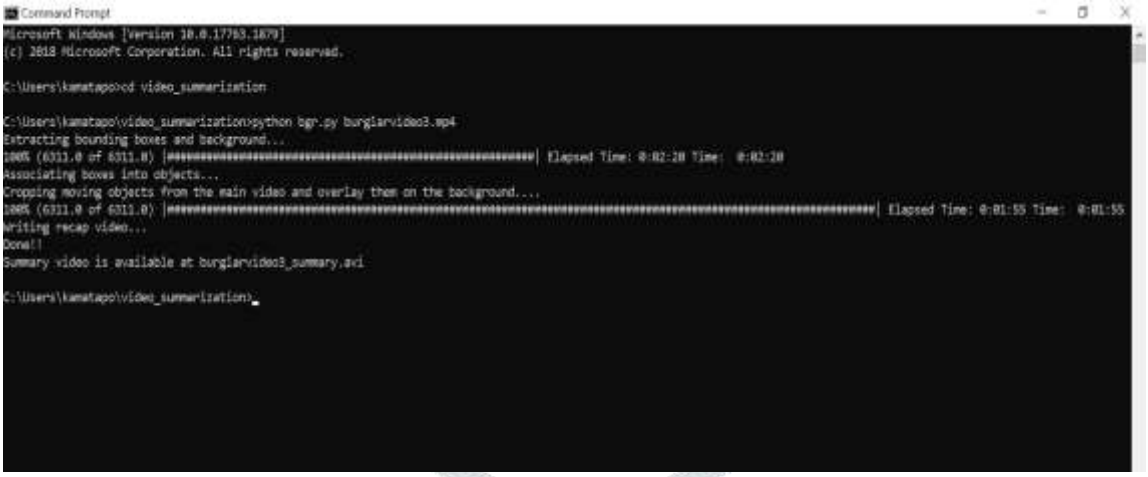


Figure 2: Generating the summarized video

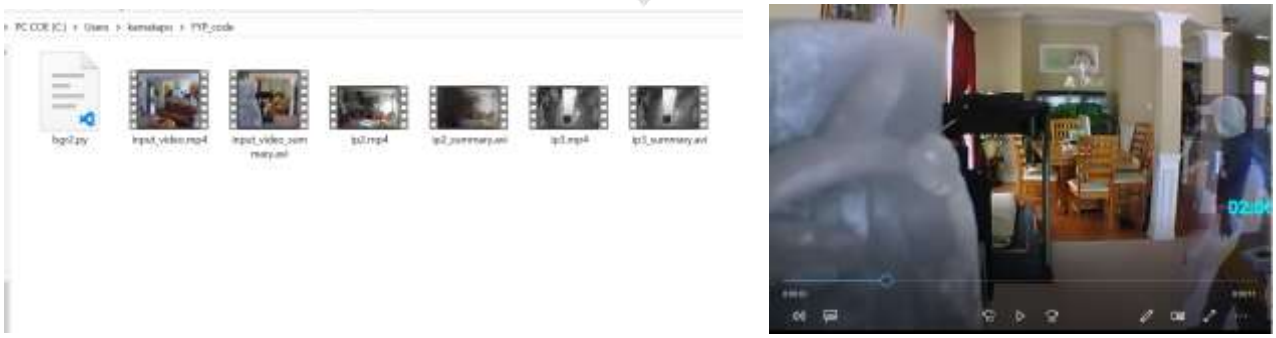
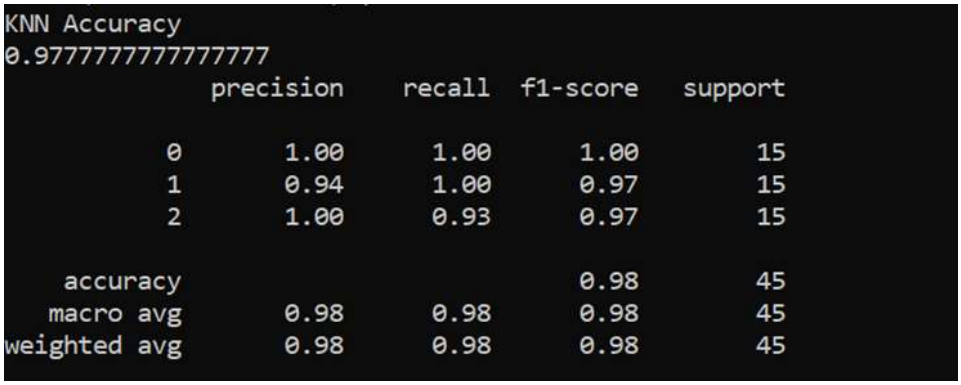


Figure 2: Output avi file generated by python code which provides summary of i/p video



KNN Accuracy
0.9777777777777777

	precision	recall	f1-score	support
0	1.00	1.00	1.00	15
1	0.94	1.00	0.97	15
2	1.00	0.93	0.97	15
accuracy			0.98	45
macro avg	0.98	0.98	0.98	45
weighted avg	0.98	0.98	0.98	45

Figure 3: Depiction of KNN accuracy

V. CONCLUSION

The proposed model aims to address some of the key issues related to security and surveillance. It tries to summarize hours of footage shot by static CCTV cameras into a short clip that shows all interesting events together. This model contributes to the betterment of the society and the community at large.

The model successfully extracted background using KNN classifier and using customized object tracking algorithm associated bounding boxes across multiple frames. The moving objects of input video were detected and tracked with sufficient accuracy. The multiple important events were overlapped and presented in the form of a single short clip. Time stamps were provided for events to aid event analysis. This model hence allows user perform surveillance for multiple events.

ACKNOWLEDGEMENTS

Throughout the process of working on the project, we needed help and guidance from our mentors. They deserve our utmost gratitude. We would like to express our special thanks to our mentor Prof. Brunda S, who gave us the opportunity to do this and gave us guidance throughout. We would also like to thank our department head Dr. M.P. Pushpalatha, who gave us a platform to showcase our work.

VI. REFERENCES

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