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CROWD DETECTION AND MANAGEMENT IN SURVEILLANCE SYSTEM

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Abstract: The steady increase in population and overcrowding has become an unavoidable factor in any public gathering or on the street during any festive occasions. The development in technology has made monitoring smart and methods of tracking humans has advanced. In order to provide an aid to this problem, our project is proposing to provide technical support to manage the crowd by detecting humans and keeping in track the count of the people in the scene. In our study, we develop a system using Raspberry Pi 3 board that consists of ARMv8 CPU that detects the human heads and provide a count of humans in the region using OpenCV-Python. A Haar cascade classifier is trained for human head detection. Human tracking is achieved by indicating the direction of movement of the person. The results of the analysis will be helpful in managing the crowd in any area with high density of crowds.

***Index Terms* – Haar Cascade Classifier, Adaboost Algorithm, Head Detection**

I. INTRODUCTION

India's high rate of increase in population, several times makes it difficult to manage it. In several occasions managing the crowd becomes a daunting task such as in temples during special occasions, in railway stations during peak hours, and so on.

In this paper, we propose a method to manage the crowd by keeping in track the count of the people in the scene.The crowd can be navigated to disperse from the crowded region by tracking the people which provides the direction of movement of people. The crowded region will be defined by the maximum permissible count of humans in a particular area.

Up until now different projects were using the tracking methods based on features like motion blobs, texture and color and head detection based on background modelling, head-shoulder detection using omega model and so on. This project focusses on training a cascade classifier for human head detection by taking positive samples (images containing human heads) and negative samples (images containing plain background).

II. CONCEPT

In this project, we develop a system using Raspberry Pi 3 board that consists of ARMv8 CPU that detects the human heads and provide a count of humans in the region using OpenCV-Python. A Haar cascade classifier is trained for human head detection. The trained cascade is then used to process the video frames in which the human heads are detected and the count of the humans in the scene is provided.

The detected human heads are then tracked using optical flow algorithm. This tracking provides the direction of motion of the persons in the scene.

III. LITERATURE SURVEY

Detection of objects by using a cascade of simple features was mainly introduced by researchers for face detection. [1] The role of Haar features extracted from an integral image in object detection is elaborated in their work.

Another method of human detection was done by using human detector that was part-based. Parts may not be clearly visible as they depend on factors inter object occlusion, illumination, etc.[2][3][4] Some other studies used foreground segmentation to detect presence of human. The background is subtracted from the frame and some types of filtering, for example Gaussian filtering, is done to extract human motion blobs out of the frame. This process is usually done in a grayscale image.[5][6] Density based head detection has been demonstrated by some researchers. The density of the crowd is initially estimated from which the heads of the individual persons are detected.In certain researches energy coefficients are used in detection crowd.[7] Head detection for tracking passengers in railway stations has also been a major field of study for many researchers. Many work has been done to look into the direction in which the passengers move through space coordinate information.

IV. BLOCK DIAGRAM

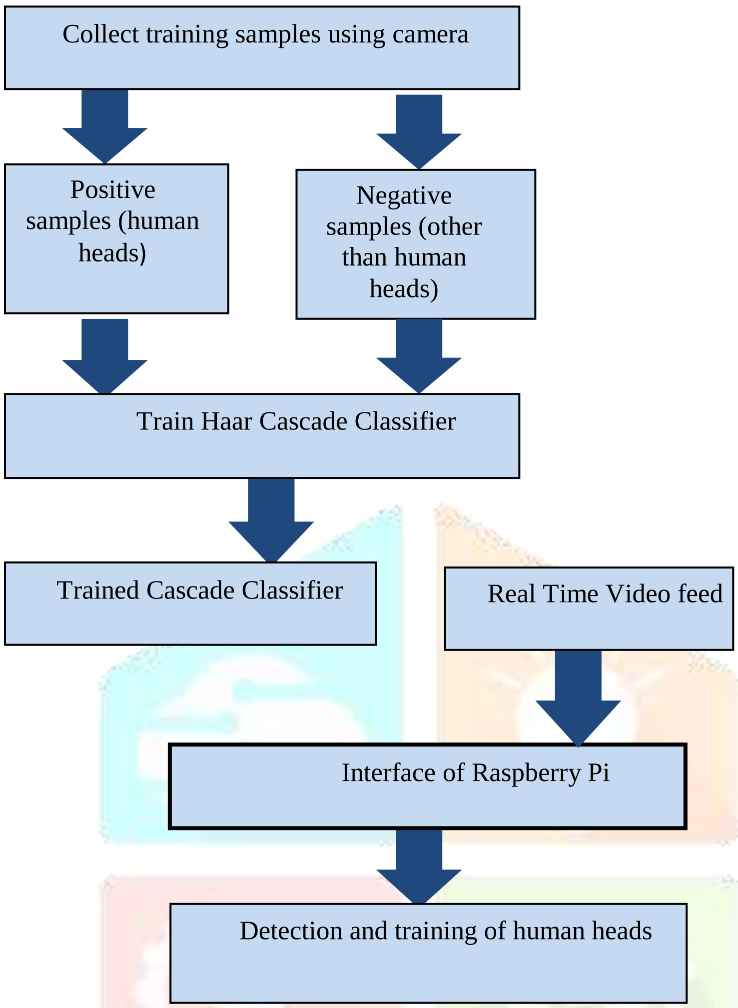

Fig no. 1Working of project

V. WORKING PRINCIPLE

The working principle of this based on three basic concepts:

5.1.Haar Cascade Classifier

Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lotof positive and negative images. It is then used to detect objects in other images.[1]

5.2.Adaboost Algorithm

Ada-boost or Adaptive Boosting is one of ensemble boosting classifier proposed in 1996.Adaboost uses an iterative procedure where different classifiers, that when used independently perform poorly, are combined to form a single strong classifier in order to increase the efficiency.

Adaboost should meet two conditions, namely, a)the classifier should be trained interactively on various weighed training examples, b)In each iteration, it tries to provide an excellent fit for these examples by minimizing training error.[6]

The procedure in which the adaboost works can be listed as follows1)Initially, Adaboost selects a training subset randomly, 2)It iteratively trains the AdaBoost machine learning model by selecting the training set based on the accurate prediction of the last training, 3)It assigns the higher weight to wrong classified observations so that in the next iteration these observations will get the high probability for classification, 4)Also, It assigns the weight to the trained classifier in each iteration according to the accuracy of the classifier. The more accurate classifier will get high weight, 5)This process iterate until the complete training data fits without any error or until reached to the specified maximum number of estimators, 6)To classify, perform a "vote" across all of the learning algorithms you built.

5.3.Optical Flow Algorithm

Optical flow algorithm is based on how images in two consecutive frames form a pattern of motion due to the motion of either object or the camera.

Each pattern acts as a 2D displacement vector field hence the head and tail of the arrow vector shows the direction of movement of the object from one from to another.

Optical flow algorithm works on several assumptions:

a)The intensities of pixel of a point object does not differ between consecutive frames, b)The pixel being tracked should have motion similar to its neighbouring pixel.[8]

The optical flow diagram not only gives the direction in which the observer is moving and the objects in the background, but also the environment and structure of objects.

VI. IMPLEMENTATION

6.1.Training

In this project we firs train a haar cascade classifier to detect human heads in a crowd cascade classifier training involves collection of positive samples and negative samples.The positive samples are the images which contain human heads and the negative samples (background images) are the images that do not contain human heads. Separate videos are taken in an area with and without humans. The videos are then processed and the frames are segmented.[5] Some of the samples we used for our training purpose. The frames with the humans are then subjected to an annotation tool which allows us to mark the human heads. The process of marking human heads consumes time but larger the number of images with marked human heads given as input better is the accuracy of head detection. Annotation tool is an Open CV application which, when executed, opens the images one after the other. A sample of our image with human heads marked using annotation tool .The tool outputs a text file containing in each line the path of each image followed by the pixel locations of the heads marked, each separated by a space.

Positive samples are then created using the annotation tool output containing the pixel locations of marked human heads in the frame and the background images. The cascade classifier is then trained and it built the small stages of classifier. A cascade classifier consists of a cascade of small stages of classifier each classifying the sub-window on the basis of certain features. The stages in the trained cascade are sorted using Adaboost algorithm. The classifier uses the Haar features extracted from the positive samples. Some researches suggest that nstages should be ideally 20 and splits should be 2.npos indicates the number of positive samples and -nneg the number of negative samples. This step is extremely CPU intensive and can take several hours/days to complete.

Fig no.2- Positive Samples

Fig no.3-Negative Sample

Fig no. 4-Marking human heads using annotation tool

6.2.Detection

We capture two real time videos in our institution using a 12 mega pixel camera one consisting of humans and the other with no persons in the scene. Surveillance cameras in crowd are specifically positioned in a particular angle and hence video is recorded in a specified angle and then trained using that video. We then segment each video into frames and save each in separate directories as positive and negative.[3][4] The video is read each frame and each frame is made to pass through all the stages of cascade classifier. A sequence of increasingly complex classifiers is called a cascade. The positive images are then marked for human heads using annotation tool. In the training of our cascade classifier using real time video frames, we use 1000 positive samples and 4400 negative samples. The training of 20 stages cascade classifier takes about 5 days. The trained classifier is then used for head detection. Video frames taken in the same scenario are tested against the trained cascade classifier. In the frames, after passing through the twenty stages of the classifier, the head regions are detected and results are obtained. Each frame is compare with several sub windows. The compared window is either passed to the next stage or refused by that stage. A window must pass through all the stages. Any stage in the classifier may reject it. After a window passes through all the stages, it is detected as the human head.

6.3.Tracking

The detected human heads are then tracked for their position in successive frames to compute the direction of motion of any person. The tracking is done by optical flow concept. Using optical flow concept, the corners of the bounding box indicating the human heads in a frame are fetched and the corresponding pixels in the successive frames are then found.[3] The movement of a person is determined by comparing the pixel values in each frame. Each person is tracked individually.[4]

VII. APPLICATION

Crowd detection can be used in local trains, buses and other daily vehicle services. One would be able to organize the frequency of trains as well as the timings of the trains based on live feed of head counts. It will be beneficial for the commuters since they won't have to face the exhaustion of travelling daily alongwith large crowds.

Tracking of human heads can be applied for surveillance purposes. It will be useful in tracking suspicious individuals or to scan a particular area for thieves.

Another application of human crowd detection and analysis is in cases of emergency evacuations. They can be planned using by studying about how crowd interacts with each other and how it reacts to certain situations. These are based on biological models and patterns, thus the movements predicted are seemingly accurate.The above mentioned model is apparently utilized within film industries to produce realistic and lifelike simulations and scenes which comes under cgi.

Other applications can be listed as follows:1. Improving a human detector using superpixels. (a) An algorithm to improve a generic human detector using an unsupervised learning framework. (b) Representation of humans in terms of superpixel-based Bag-of-Words representation.

2. Part-based multiple-human tracking with occlusion handling (a) An algorithm to track multiple humans using online-learned person-specific classifiers. (b) Representation of humans in terms of part-based model to capture the appearance variations. (c) An occlusion handling approach to improve human detection performance in crowded scenes. (d) An approach to overcome partial occlusions for human tracking. 3. Multiple-human segmentation leveraging human detector

(a) An algorithm to automatically segment multiple humans in videos based on human detections. (b) Representation of humans in terms of the part-based detection potentials to capture the spatial distribution (c) A new approach to using tracklet-based CRF optimization to smooth the segmentation boundaries. 4. NONA: An efficient tracking system (a) A computer vision system for real-time human tracking in high- resolution videos. (b) A multi-threaded architecture to process video ingestion, tracking and video output simultaneously. (c) A novel approach to using local frame differencing to handle long-term occlusion.

VIII. FUTURE SCOPE

Tracking a target across different cameras would be a very useful application for wide area surveillance. The challenge is to Crowd behavior analysis is going to be the future talk which is sometimes also reffered as crowd artificial intelligence or swarm intelligence. However, there are some difficulties in analyzing behavior in a crowd scene. In order to achieve the goal, the analyzing procedure must be done comprehensively through video surveillance. Human instincts are put to test and are applied to biological and artificial models that form a complex system of multiple agents and their interactions. This section explores some of the possible directions our work may be taken in the future. Motion-based human detection Our proposed human detection method used only static features such as superpixels or HOG, while in videos the motion features, e.g. Histogram of 124 Optical Flow (HOF), can also provide very discriminative information. Since the local motion patterns of humans are different from the background or other objects, these correctly associate a person appearing in different cameras, each with differing viewpoints and lighting, whilst considering the spatial and temporal constraints. Human pose estimation based on segmentation. One interesting area to explore is estimating human poses in videos.

IX. CONCLUSION

Crowd management using head detection is realized using computer vision in our study, implementing our study using video taken from our institution. We use Haar features and Adaboost algorithm to detect the person's head region. We track the human using optical flow concept. Using increased number of samples, the results are found to be efficient. The human detection and tracking can generally be used in surveillance tasks.

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