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An Efficient Real Time People Counting System based on Identification and Tracking using Surveillance Camera

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ABSTRACT—*A Framework for track human motion in an enclosed atmosphere from sequences of monocular gray scale pictures that are obtained from mounted cameras. The detection of objects that are moving uses background subtraction algorithm which is working based on Gaussian mixture models. Variable Gaussian models square measure applied to seek out the most likely matches of human movements between successive frames taken by cameras mounted in varied locations. The modified Kalman filters is used for tracking objects in each frame, and determine the possibility of each detection is being assigned to each track. An important aspect of this project is Track maintenance.*

Keywords: Tracking, Background Subtraction, Segmentation, Coarse detection, counting.

I. INTRODUCTION

This projects shows that people's counting and tracking are key activities in many applications, including motion recognition, traffic monitoring, automotive protection, and observation. Tracking human motion in an enclosed atmosphere is of interest in applications of surveillance. Specifically, we are developing a technique to trace people at such as corridor, airport, border, and secured building. This requires that the monitoring system be able to copy the tracked subject during a broad space over an extended amount of tracking time. The work has evolved from learning human walking employing a fastened camera to following non-background objects during a single moving camera[1]. The studies in tracing by using mounted single camera are limited to a really narrow space owing to the restricted viewing angle of the system. A moving camera with a considerable degree of move freedom will increase the viewing angle to bound degree; however, it complicates the implementation by adding the motion estimation of each the viewing system and also the subject of interest, and continues to be restricted in the amount of viewing space. During this work, we have a tendency to select to use multiple fastened cameras mounted within the space of interest to track and monitor the motion of people in sequences of monocular grayscale pictures. As long because the subject is within the realm monitored by the fastened cameras, the image of this subject are contained within the read of a minimum of one tracking human motion in an inside atmosphere is of interest in applications of police investigation. Specifically, we are developing a technique to trace people at sites such as corridors, airports, borders, and protected buildings. This requires that the viewing system be ready to image the tracked subject during a broad space over an extended amount of your time. In pursuit of this goal, our work has evolved from learning human walking employing a fastened camera to pursuit camera. Supported this situation, the matter of observation a subject becomes that of pursuit the topic of interest one camera read and matching that subject across completely different camera views, wherever the cameras intrinsic parameters and relative positions area unit assumed to be acknowledged a priori. To establish correspondence between consecutive frames from completely different cameras, typical pursuit ways based on the similarity of the item form, like cross correlation and line-edge matching[2], don't seem to be applicable as a result of the form of Associate in Nursing object image varies drastically from view to look at of various cameras, and also the whole body of a moving human typically goes through sophisticated changes during motion. In addition, the continuity of the motion flow doesn't retain in the views of multiple cameras. Optical flow[3] ways, which area unit wide used for plain motion pursuit, demand tiny and swish motion between frames, a restriction that conjointly doesn't hold in our case. During this paper was propose to track a moving human in several camera views supported low level recognition of human motion. An easier kind of human model is applied to find moving human subjects. Pursuit between consecutive frames is especially based on the consistency of the position, velocity, and average intensity of feature points developed by variable Gaussian models, thought of within the views of varied cameras. The planned algorithmic rule is computationally economical and can be without delay utilized in real time applications. Thus the tracking and counting of people in real time applications that can accomplished through the pre-processing techniques.

II. STAGES ON PREPROCESSING

The stages of pre-processing are executed on tracking are,

1) Segmentation

2) Detection of human subjects, and

3) Feature extraction.

SEGMENTATION

The planned segmentation methodology takes benefit of the belongings of time-dependent information. Since we have a tendency to area unit exploitation fixed cameras, the background image from identical camera view remains comparatively unchanged. Once the background image is recovered, pictures of the non-background objects are often separated from the background image by variation and threshold. Consequent step is to get pictures of non-background objects at intervals totally different bounding boxes. The window slicing method to the thresholded binary image in a coarse to superior manner. The binary image is primary ironed by a five mean filter before we have a tendency to calculate its corresponding parallel and perpendicular profiles. Then valleys of the smoothed profiles area unit thought of to be the limitations of the rectangle boxes that containing non-background objects[4].

COARSE PEOPLE DETECTION

Various techniques for modeling the physical bodies have been developed by researchers. The human body is pictured either as a drawing or as a volumetrically model. During this work, proposed to use a rough second model various filter mechanisms[5]. Supported the observation that the humans head and trunks doesn't amendment as drastically because the hands and legs throughout the motion, our technique makes an attempt to find the pinnacle and trunk employing a coarse second model of the physical body. The human head is sculptures que as Associate in nursing eclipse with a height to breadth ratio of one to one. The human trunk is pictured as a parallelogram with a height to breadth magnitude relation between one and three taking into consideration the special angles of body projection to the viewing camera. Figure.1 shows all the ratios are study from trial of picture of humans from completely different points of read. To start with, we glance for the placement of the pinnacle considering the area of a blob that is in keeping with is the axes of the eclipse[8]. If the world of any high sub-region within every

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bounding box is comparatively consistent with the higher than relationship, to declare that this may well be a head. Otherwise, we tend to exclude it from additional thought.

Figure 1: Identification of human in an image

FEATURE EXTRACTION AND BACKGROUND SUBTRACTION

We choose points happiness to the medial axis of the superior body because the feature for chase. Victimization multiple feature purposes instead of one point makes the matching of an equivalent subject between consecutive frames additional reliable.

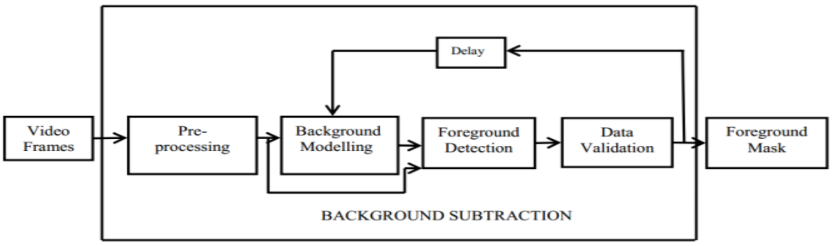

Figure 2: Background Subtraction

Based on this assumption, we tend to continually treat the dimension of a bounding box as true info and modify the peak consequently thus that all the bounding boxes for comparison as shown in figure.2, have an equivalent width to height quantitative relation.

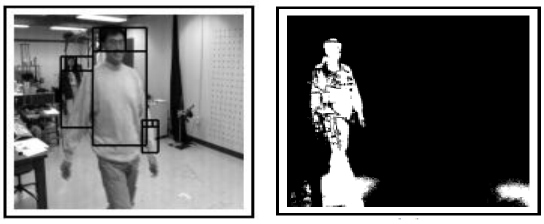

Figure 3: Feature extraction on images to reduce background

III. TRACKING

To begin with, we tend to monitor the target at intervals the read of one mounted camera. Then the system follows the topic moving across the viewing boundary of 1 camera to a different. As long because the target is at intervals the sector of read of the system cameras[11], it will perpetually is half-track across numerous video streams captured from the cameras. Therefore, the following task during this setup consists of 2 major parts: 1) following a human within the read of 1 mounted camera, and 2) following a

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human across completely different camera views as in figure 4. Track maintenance becomes a main aspect of this project.

Figure 4: Tracking on human action in surveillance

Algorithm 1: modified Kalman Filter

- $\mathbf{F}_k$ - state transition model and previous state $\mathbf{x}_{k-1}$
- $\mathbf{B}_k$ - control-input model and control vector $\mathbf{u}_k$
- $\mathbf{w}_k$ - process noise and their state covariance $\mathbf{Q}_k$

Predict:

State estimation

$$\hat{\mathbf{x}}_{k|k-1} = \mathbf{F}_k \hat{\mathbf{x}}_{k-1|k-1} + \mathbf{B}_k \mathbf{u}_k$$

Estimate covariance

$$\mathbf{P}_{k|k-1} = \mathbf{F}_k \mathbf{P}_{k-1|k-1} \mathbf{F}_k^{\mathrm{T}} + \mathbf{Q}_k$$

Update:

Measurement residual

$$\tilde{\mathbf{y}}_k = \mathbf{z}_k - \mathbf{H}_k \hat{\mathbf{x}}_{k|k-1}$$

Innovation covariance

$$\mathbf{S}_k = \mathbf{H}_k \mathbf{P}_{k|k-1} \mathbf{H}_k^T + \mathbf{R}_k$$

Best Kalman filter gain

$$\mathbf{K}_k = \mathbf{P}_{k|k-1} \mathbf{H}_k^T \mathbf{S}_k^{-1}$$

Updated state estimate

$$\hat{\mathbf{x}}_{k|k} = \hat{\mathbf{x}}_{k|k-1} + \mathbf{K}_k \tilde{\mathbf{y}}_k$$

Updated estimate covariance

$$\mathbf{P}_{k|k} = (I - \mathbf{K}_k \mathbf{H}_k) \mathbf{P}_{k|k-1}$$

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IV. COUNTING

Counting of people entering in the surveillance are can be done by many individuals enter, walk around, and exit the workspace. The edge and also the actual count are plotted. The edge was terribly high and isn't planned. The edge matches the particular count fine. As explained earlier, the edge is tighter than the higher bound as a result of the character of the LBC constraint. Additionally, the UBC constraint is even weaker here as a result of the actual object size is unknown and completely different for every person.

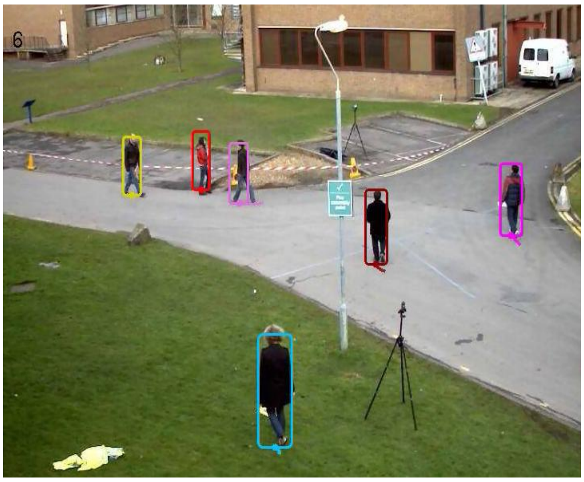

Figure 5: Tracking and counting of peoples

The smallest minimum object size should be used, making the edge even larger. Also, permitting individuals to penetrate and leave weakens the bounds for polygons close to the sting. to urge a far better lower bound for these edge polygons, once a polygonal shape within the workspace moves to the sting, the edge isn't in real time set to zero. Instead, the lower bound is ready to zero once the polygonal shape disappears from the sting. The trade-off is that once individuals walk on the edge, the edge is tighter, however once individuals exit, there will be a lag within the edge before it catches up to the real count. That is often why within the figures the edge lags behind the particular count once individuals exit.

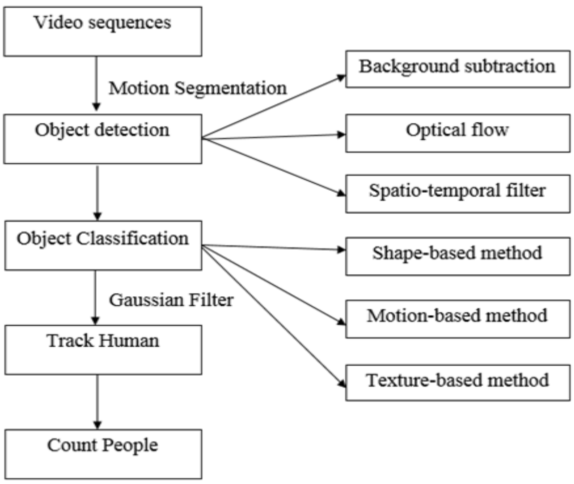

Figure 6: Block Diagram of people counting

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```
---- JUMP  MOVES  ROUND 9 ----
merging......done
merging does no good!
Target:     1   2   3   4   5   6   7   8 Tars Frms
grow bck:   -   -   -   -   -   -   -   -    0    0
grow frw:   -   -   -   -   -   -   -   -    0    0...done
growing does no good!
Target:     1   2   3   4   5   6   7   8 Tars Frms
shrk pst:   -   -   -   -   -   -   -   -    0    0
shrk ftr:   -   -   -   -   -   -   -   -    0    0...done
shrinking does no good!
splitting.............done
split does no good!
creating targets.......done
adding does no good!
removing targets.............done
purge does no good!
No jumps were executed. Optimization has converged after 9 epochs.
All done (0.29 min = 0.00h = 0.16 sec per frame)

Evaluation 2D:
 Rcll  Prcn   FAR| GT  MT  PT  ML|  FP   FN IDs  FM|  MOTA  MOTP MOTAL
 98.2  99.8  0.01|  7   7   0   0|   1    9   1   0|  97.9  75.4  98.0

Evaluation 3D:
 Rcll  Prcn   FAR| GT  MT  PT  ML|  FP   FN IDs  FM|  MOTA  MOTP MOTAL
 98.2  99.8  0.01|  7   7   0   0|   1    9   1   0|  97.9  86.1  98.0
```

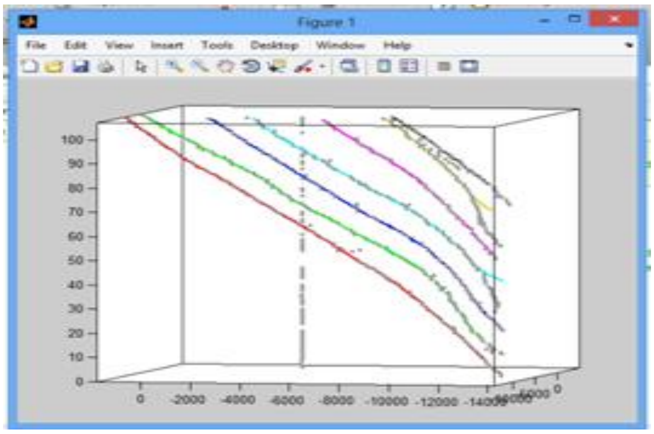

Figure 7: Count Analysis graph

V. CONCLUSION

This projects shows that people's counting and tracking are key activities in many computer vision applications. The use of the Kalman filter for tracking objects and focuses on three important features namely; First stage is Prediction of object's future location, then Reduction of noise introduced by inaccurate detections. Final stage is facilitating the process of relationship of multiple objects to their tracks. This Kalman Filter is to detect and counting the peoples can be used to analyze in any platforms. Detection is also a first step to performing more difficult tasks such as tracking or classification of people's by their type. Finally, the peoples are estimated using tracking-based detection technique is realized and that can accomplish real time efficiency.

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