

# Tracking People Motion Based on Lloyd's Clustering Algorithm

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**Abstract**—People counting systems are widely used in surveillance applications. In this paper, we present a solution to people counting based on information provided by an overhead stereo system. Three fundamental aspects can be identified: the detection and tracking of human motion using a particle filter, and a Lloyd's clustering algorithm to provide the number of hypotheses at each time, and, finally, trajectory generation to facilitate people counting in single directions. The proposed algorithm is designed to solve problems of occlusion, without counting objects such as shopping trolleys or bags. We validated various test videos, depending on the number of people crossing the counting area.

**Index Terms**— Lloyd's algorithm, motion detection, people counting, tracking people.

## I. INTRODUCTION

The objective of video tracking is to associate target objects in consecutive video frames. The association can be especially difficult when the objects are moving fast relative to the frame rate. Another situation that increases the complexity of the problem is when the tracked object changes orientation over time. For these situations video tracking systems usually employ a motion model which describes how the image of the target might change for different possible motions of the object. To perform video tracking an algorithm analyzes sequential video frames and outputs the movement of targets between the frames. There are a variety of algorithms, each having strengths and weaknesses. Considering the intended use is important when choosing which algorithm to use. There are two major components of a visual tracking system: target representation and localization, as well as filtering and data association. Target representation and localization is mostly a bottom-up process. These methods give a variety of tools for identifying the moving object. Locating and tracking the target object successfully is dependent on the algorithm. For example, using blob tracking is useful for identifying human movement because a person's profile changes dynamically. Typically the computational complexity for these algorithms is low. Similarly, many businesses within the service sector need to conduct statistical analyses of their sales access points in order to monitor customer flow at different times of the day and adjust sales personnel presence accordingly, identify the areas which customers visit most, etc. Such systems are usually positioned at the entrance and exit doors of buildings, department store

aisles, hospital corridors, etc. As reported in [2], the problem of people counting has generally been addressed using relatively inefficient systems, such as turnstiles to reduce the flow of people moving through an area. Other systems have been based on optical barriers, which produce a high error rate both in terms of false negatives, by failing to discriminate between different people walking in parallel and false positives, by including objects such as bags and cases in the people count.

Several alternatives to these systems are based on computer vision. These constitute low-cost nonintrusive systems which are capable of resolving some of the problems mentioned earlier and which yield a relatively high hit rate. In addition, some of these systems have the ability to track people crossing the camera's field of view, increasing robustness by taking several measurements corresponding to the same person in the video sequence.

An effective method for estimating the number of people and locate each entity in a low resolution image with difficult scenes.[3]. A novel approach for automatic people counting in videos captured through a predictable closed-circuit television(CCTV) using computer vision techniques.[4]. A geometric algorithm that calculates bounds on the number of persons in each region of the shelf, after specter regions have been eliminated.[5]. A number of observed studies both on naturally generated data and on real data sets from applications in color quantization, data compression, and image segmentation.[9]. In this paper, we present a unidirectional people counting system based on computer vision and propose solutions to various common problems such as the occlusion of people and discriminating between people and objects such as shopping trolleys or bags in stores.

## II. METHODOLOGY

We propose the use of the Lloyd's clustering algorithm, based on optical flow generated from the movement of people and depth to the height of the system, as an estimation method for multiple people. The Lloyd's clustering algorithm is used to provide a deterministic output. The inclusion of different features relevant to people tracking, such as movement, size, and height, adapting the propagation and observation models in the particle filter and followed by a clustering method, provides sufficient accuracy and robustness to achieve high counting rates. The Module flow of this project is shown in figure 1.1

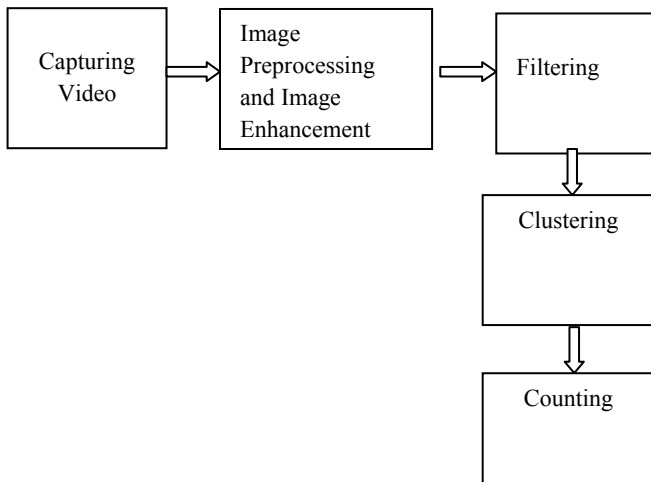


Figure 1.1 Module Flow

**A. Image Capturing**

Capturing image using video camera, it is the process of recording the movement of people or object. In this we used the Lloyds algorithm based on optical flow generated from the movement of people and depth to the height of the system. As an estimation method for multiple people using camera capture the image.

**B. Image Preprocessing and Enhancement**

Precious bits are wasted on noisy video. Color correction can mask noise shown in figure 1.2. It's used to improve the overall image quality. Deinterlacing, scaling, and color space down sampling are most commonly used video preprocessing functions. Gamma correction is also an important step in the preprocessor because PC monitors tend to be darker than the television sets.



Figure 1.2 Image preprocessing

Image enhancement is performed in order to enhance the quality of the video or frame. Through this the tracking can be made still clear. Processing of image to bring out specific feature of an image [7]. Enhancement is the modification of an image to alter impact on the viewer. Generally enhancement distorts the original digital values. The aim of image enhancement is to improve the

interpretability or perception of information in images for human viewers, or to prove 'better' input for other automated image processing techniques.

**C. Particle Filtering**

The ability of the particle filter [8] to deal with non-linearities and non-Gaussian statistics suggests the potential to provide improved robustness over existing approaches show in figure 1.3. The algorithm is simple to implement. Tracking can be achieved using a particle filter, with minimal pre-calibration of structure and the ability to incorporate new structure during tracking.

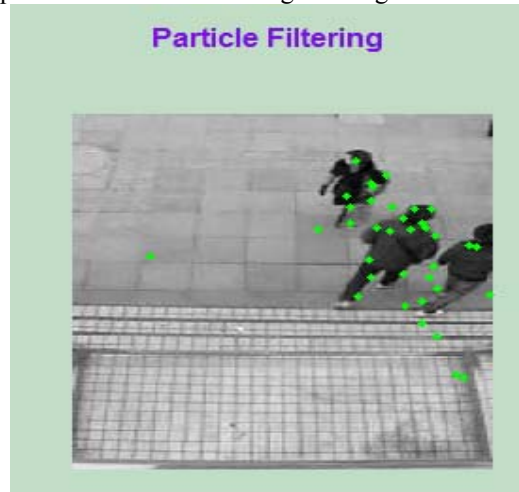


Figure 1.3 Particle Filtering

After the particle filter then subtract the background from each frames show in figure1.4.



Figure 1.4 Background Subtraction

**D. Lloyd's Clustering**

This method will continue to recalculate the cluster centers and reassign points until the intra-cluster variance stops decreasing. Lloyd's algorithm is still very effective at clustering multi-dimensional data. Specifically, creating a template class for clustering with Lloyd's algorithm allows for use in any domain, where the only distinctions per subclass would be the k value, the data points, and the distance measurement. With the help of this algorithm the head of the people present in video can be segmented. The algorithm improves centroid positions by iterating the following two steps:

**Step one:**  $s_i = \{ x_j : \| x_j - \mu_i \| \leq \| x_j - \mu_c \| \ \forall 1 \leq c \leq k \}$

**Step two:**  $\mu_i = \frac{1}{|s_i|} (\sum_{x_j \in s_i} x_j)$

In **step one** all data points,  $x_1 \dots x_n$ , are assigned to one of its closest centroid,  $\mu_i$ . The process of finding a closest neighbors is called nearest neighbor search.

In **step two** all centroids,  $\mu_1 \dots \mu_k$ , are updated by calculating the mean of all data points in the cluster.

Lloyd's method was originally used for scalar quantization, but it is clear that the method extends for vector quantization as well. Commonly used initialization method is random Partition. The Random Partition method first randomly assigns a cluster to each observation and then proceeds to the update step, thus computing the initial mean to be the centroid of the cluster's randomly assigned points. Random Partition places all of them close to the center of the data set.

Random portioning is a particle filtering process. Separate the particles from the image. Identified particles are used for segmentation. Convert the particle places into black and white region which is done by background subtraction. Collect all white pixels from the black and white image. Cover the unconnected pixels into connected region. Lloyd's algorithm starts by an initial placement of some number  $k$  of point sites in the input domain. Lloyd for finding evenly-spaced sets of points in subsets. It repeatedly finds the centroid of each set in the partition. Initially separate the front objects from background. Segment the objects in the image. Remove the small particles from the image. Centroid values are considered as blobs. Set label to each segmented objects. It returns number of blobs in the segmented image. Save blob numbers in a variable.

**E. Counting**

The heads of the persons present in the video at any tilted position can be tracked using the particle filtering and Lloyd's algorithm. The numbers of persons are also identified and the counted results will be displayed.

**III. TRACKING AND COUNTING**

The process of locating a moving object over time using a video. Tracking is the problem of determining the positions and other relevant information of moving objects in image sequences. Filtering and data association is mostly a top-down process, which involves incorporating prior information about the scene or object, dealing with object dynamics, and evaluation of different hypotheses. These methods allow the tracking of complex objects along with more complex object interaction like tracking objects moving behind obstructions. Additionally the complexity is increased if the video tracker is not mounted on rigid foundation but on a moving ship, where typically an inertial measurement system is used to pre-stabilize the video tracker to reduce the required dynamics and bandwidth of the camera system. The computational complexity for these algorithms is usually much higher. Tracking people or objects in video involves the modeling of non-linear and non-Gaussian systems.

To perform the counting it is necessary to construct trajectories using the detections. The calculation of the

distance between trajectories and detection is carried out using the Euclidean distance of the characteristics that from a detection. Counting [6] system consist of single camera located three meter above the floor which acquires image.

- a) **Detection problems:** The lack of contrast between the floor and the person moving through the counting area produced a low difference between successive images which was not detected, increasing the rate of false negatives[2].
- b) **Slow movement problems:** People stopped in the counting area, or presented very slow movement, generating insufficient optical flow. Where intervals of consecutive images occurred (stop-and-go), which contain detectable movement, a valid count was always obtained. Otherwise, the individual was not counted.
- c) **Deterioration problems:** These may occur when multiple people (more than four) interact through the counting area. The subset  $N - M$  in the selection stage requires a larger number of particles to represent the posteriori, as low efficiency values are obtained. Thus, in the clustering method, some hypotheses are not identified. Note that the detection rate decreased when there was an increase in the ratio number of people/area.

**IV. EXPERIMENTAL RESULTS**

We present a solution to people counting based on information provided by an overhead stereo system. Three fundamental aspects can be identified: the detection and tracking of human motion using an particle filter, and a Lloyd's clustering algorithm to provide the number of hypotheses at each time, and, finally, trajectory generation to facilitate people counting [1] in single directions. The databases are of three types: video database, frame database and Background subtraction database. During the process of counting people, existing video is separated in to frames and stored in the database. We have verified the proposed method in MATLAB 8.2 on Intel core 2 Duo Windows 7 laptop. Frame and Background subtraction an video is collected as a set and stored in the internal data base.

**A. Tracking people using video**

Tracking based on the number of frames in the video shown in the figure 1.5. Tracking is the problem of estimating the positions and other relevant information of moving objects in image sequences. Tracking Result is displayed the frame number and people count in each and every frame.

| Frame Number | People count |
|--------------|--------------|
| 1            | 3            |
| 2            | 3            |
| 3            | 4            |
| 4            | 3            |
| 5            | 3            |
| 6            | 3            |
| 7            | 4            |
| 8            | 5            |
| 9            | 5            |
| 10           | 5            |
| 11           | 5            |
| 12           | 5            |
| 13           | 4            |
| 14           | 4            |
| 15           | 6            |
| 16           | 5            |
| 17           | 7            |
| 18           | 6            |
| 19           | 6            |
| 20           | 6            |

Figure 1.5 Tracking Result

### B. Counting people using video

The heads of the persons present in the video at any tilted position can be tracked using the particle filtering and Lloyd's algorithm. The total numbers of persons are also identified and the counted results will be displayed. Result shown in figure 1.6.

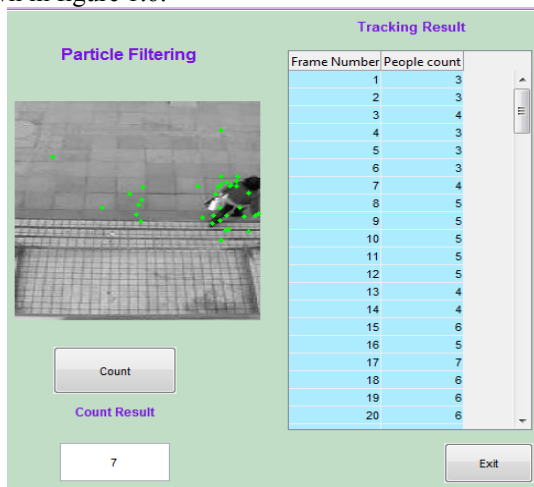


Figure 1.6 Total Number of People

### V. CONCLUSION

In this paper, we have presented a new proposal for unidirectional counting based on images from an overhead video. The particle filter provides the probabilistic and multimode characteristics necessary to carry out multiple-hypothesis tracking. The Lloyd's clustering method is incorporated in order to provide deterministic output. A minimum degree of movement is required for human motion to be considered measurable motion. Several types of movements, such as stop-and-go, are processed acceptably. The main role of this paper is the placing of movement,

size, and height features relevant to people tracking, adapting a particle filter followed by the completion of a clustering method, providing robustness to the algorithm. This stage provides a regular execution time regardless of the number of hypotheses. The proposed algorithm presents problems of particle set weakening when more than four people interact, crossing the counting area at the same time.

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