ABSTRACT:

Digital Image processing has expanded and diversified into several branches based on mathematical tools as well as applications. An effective approach for detection of small objects with low contrast is proposed. In our work, small moving objects are detected in an image sequence captured from a video camera. Now a days robotics as become more popular due to its diverse applications. Vision to a robot has extended the range of applications and it is rapidly developing. Vision applications generally are used for finding a part and applying it for robotic handling or inspection before an application is performed. In this paper we developed algorithm & implemented on robotic system having embedded processor and then process the image that detects & track the object in real time.

Keywords: Object tracking, Real time, ARM processor, Median Filter, Image processing

[1] INTRODUCTION

The problem of object detection can be seen as a classification problem, where to distinguish between the object of interest and other background objects. With the arrival of SOC technology it is now possible to integrate complex hardware functionality on a single chip. For this reason it is important that such components are highly optimized in terms of speed while using a relatively small section of the available embedded memory. The object recognition and manipulation algorithms are characterized by their computational complexity due to the size of both the image and the source system added to the large number of complex arithmetic operations. It is extremely desirable that such applications are performed on a standard SOC embedded processor without the need for large
and expensive memories and co-processors. The object recognition and manipulation algorithms are characterized by their computational complexity due to the size of both the image and the source system added to the large number of complex arithmetic operations. The model used in image processing applications to detect object on basis of its appearance can be broadly classified as (a) model-based technique, in which the model of predefined in the system is compares with the current image frame to determine the presence of object. This may include features like lines curves etc (b) appearance-based technique, wherein the variation in the appearance of object are used to train the object models (c) local appearance technique uses small part of an object to train the object models [1]. The detection and processing of the small moving targets is an important subject in the area of signal/image processing, especially in the condition of complicated background and long ranges. Many pre-processing algorithms have been reported in the literature. Some of them are spatial and others are either temporal or spatiotemporal in nature. Particularly, noise is a critical problem encountered in object detection, which might severely affect the detection results. The detection results are usually very poor when the detected objects are small and with low contrast by employing traditional image differencing methods. To remedy the problem, an effective and efficient object detection method is proposed in this paper to detect small moving objects with low contrast in video sequences. In this work we considered the single object tracking. The motivation behind this work is to develop software for tracking which has the major application in security, surveillance and vision analysis. The developed software must be capable of tracking any single object moving in the frame and to implement on a hardware which is capable of on board calculations with high performance and low power consumption.

Embedded system presents a new technique for the detection of ICs within images of PCBs which uses region growing.

[2] METHODS ON OBJECT DETECTION IN REAL TIME EMBEDDED SYSTEM

A. Algorithm of Image Processing using Median filter

The implementation of an image processing algorithm on embedded system is a critical task due to complexity in implementation. As a standalone system, various factors like memory, power consumption, space, etc. has to be considered while selecting the platform and implementing the image processing algorithm. Here, an algorithm to detect object is implemented on the embedded processor board (EP9302) with embedded-OS ported on it. The main purpose of this system is to detect and track the object in the real time world and determine direction in which the robot should move so as to reach near the object. To detect the object a USB camera is used which is interfaced to processor. The output of camera is in compressed format which is decoded by the processor and stored in memory. As the image frame is in color format (RGB format), it requires more processing time therefore, the complete frame is converted to 8-bit gray scale image.

The median filter is the crux of this implementation. The object of interest is bigger in size then the other smaller objects are assumed to be as noise present in the image frame. As the property of median or averaging filter is that it removes noise from the image or in other words smoothen the image and detect the object. Initially, the bot is at a certain maximum distance, defined by the application. When distance (d) between bot and target is maximum, the object would appear to be smaller in size as compared to complete image frame captured by the camera.
In other words, the pixels covered by the object in the image frame would be less and therefore the median filter of smaller size is used to ensure that after smoothening the image only the object is clearly seen in the image. The filter size is decided by the specifications of application. Now, as the robot system (Bot) advances toward the object, the object would appear to be larger i.e. it covers more and more number of pixel in the image frame and hence the filter size is increased as the bot advances forward. After filtering, as only the object of interest is present in the image frame, correlation is used to get the approximate centroid of the object.[1]

B. Noise Removal and ROI Locating Method

The detection of small objects in video sequences is implemented based on imagedifferencing technique. Under the processed environment, the number of noise pixels could be much more than the number of target pixels. Hence, the histogram-based technique adopted in traditional imagedifferencing method is inappropriate to resolve the problem. Median filterbased approach is the commonly used method for noise removal in image processing. However, this approach will eliminate not only noise but also small targets. To remedy this problem, a novel noise removal algorithm is devised to remove the clutter noise by encoding each pixel and its neighbors according to the noise distribution.[3]

By assuming noise to be Gaussian-distributed, we deductively conclude that any pixel is not possible to be surrounded by four or more noise pixels. Hence, only the pixels surrounding by three or less than three non-zero neighbors need to be examined in a difference image. From this point of view, the method encodes every pixel and its neighbors and then builds a histogram to determine noise threshold in the difference image. With noise being removed, the regions of interest (ROI) can thus be accurately obtained for later contour extraction.[3]

C. Pre-Processing Filtering Method

The pre-processing algorithms are important in the small target detection. The usefulness of various spatial as well as temporal filters have been discussed. Irrespective of the method chosen, the pre-processing filter should perform the tasks of enhancing the isolated points (small targets occupy single isolate pixel in the image plane), preserving the edge information and giving a weak response in the homogenous region have no direct application in small target detection, but they also have been studied in this survey.[2]

1. Spatial Filtering Method:

A common method of target detection based on small size spatial filters works by predicting the background by image processing techniques and subtracting it from the original simage. Gaussian, statistical and morphological filters have been explored for small target detection applications. Recently, clutter suppression based on top-hat filter has been proposed. Background inhibition network model and Renyi’s entropy based pre-processing algorithms have been reported by Weidong. Modified top-hat transform-based background suppression and target detection have been presented by Xiangzhi Bai. An integrated algorithm based on wavelet-transform and higher order is reported in statistic25 for low SNR target detection.

2. Gaussian Filtering method:
The Gaussian smoothing operator is a 2-D convolution operator that is used to blur images and remove detail and noise. It uses a kernel that represents the shape of a Gaussian (bell-shaped) hump. Gaussian smoothing uses this 2-D distribution as a point-spread function. This is achieved by convolution. Since the image is stored as a collection of discrete pixels, a discrete approximation to the Gaussian function is needed to perform the convolution. The kernel can be truncated at 3σ (σ: standard deviation) limits from the mean.

3. Statistical Filtering method:

The statistical filters reported in literature for smoothing images are mean, median, maxmedian, max-mean and selective median.

4. Mean Filtering method:

It is simple, intuitive and easy to implement. It reduces the amount of intensity variation between one pixel and the next. Each pixel value in an image is replaced with the mean of its neighbors, including itself. This eliminates pixels which are unrepresentative of their surroundings. Mean filtering is based around a kernel, which represents the shape and size of the neighborhood to be sampled when calculating the mean. Often a 3×3 square kernel is used, although larger kernel sizes or repetitive usage of small kernel may be used for better (but not identical) results.

5. Median Filtering method:

It is used to reduce, like mean filter, noise in an image. However, it is better in preserving useful detail in the image than the mean filter. Like the mean filter, the median filter considers each pixel in the image and replaces it with the median of the neighbourhood pixel values. The median filter has two main advantages over the mean filter:

- It is a more robust estimation than the mean. A single unrepresentative pixel in a neighborhood will not affect the median significantly.
- It does not create new unrealistic pixel values, since the median must actually be the value of one of the pixels in the neighbourhood.

6. Max-median/Max-mean Filtering method:

These remove the shortcomings of median/mean filters (loss of important features of interest). These filters effectively remove noise and preserve geometrical features of the signals and are called maxmedian filters.

7. Selective median Filtering method:

It is a special form of median filter. It replaces the central pixel with a local median of selected pixel intensities inside the window. The background reconstruction is performed using a median filter.
of window size n*n. By considering alternate pixel position for the median filter, it is able to capture even dim targets with gradually decreasing intensity.

8. Morphological Filtering method:

Mathematical morphology which is based on shape provides an approach to the processing of images. The morphological operations tend to simplify image data, preserving their essential shape characteristics and eliminating irrelevances. The fundamental operations of mathematical morphology are dilation and erosion.

9. Gradient Weighted Background Reconstruction (GWBR) Filtering method:

The gradient-weighted background reconstruction (GWBR) filter is proposed to suppress the strong undulant clouds.[3]

D. Image Processing Algorithm for Robotics

The main purpose of this system is to detect the object in particular image frame and direction in which the robot should move so as to reach near the object. To detect the object we will use camera which is interfaced to microprocessor. This camera continuously captures frames in the form of stream and it will check for object in that frame. The V4L(Video4Linux) APIs provides with the functionality to control the capturing device. The frame obtained in the main memory (SDRAM) which is then processed using different image processing algorithms. The image is captured using USB webcam. The image is stored in RAM as there is no need to store image permanently. The pseudo algorithm of image processing is as follows-

i. Capture the image frame.
ii. Decode the image by extracting Y-component from YUYV format.
iii. Convert the extracted Y-component into proper image frame iv. Negate the image v. Filter the image to remove noise vi. Extract the object from frame vii. Calculate the object location viii. Measure the angular distance between the object and the orientation of the robot.’ After the detection of object, the direction in which robot should move is calculated depending upon the location of object in the frame. Then depending upon the direction of movement, the motors are actuated to get the movement in the desired direction.[4]

[3] CONCLUSION

We have discussed a several strategies for object tracking and detection in real time embedded system. There are several negative effects of some of the methods like Noise Removal and ROI Locating where we can remove only noise of the input image. The used algorithms take more computations. To overcome these limitations new methods to be develop. The main objective of this survey is to help researchers to select suitable methods for object tracking and detection.
REFERENCES


