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Animal Detection using Background Subtraction & Blob Detection Technique

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Abstract: Animal detection plays an important role in day to day life due to its impact on the human life directly or indirectly. In the area like an airport where the presence of any kind of animal is strictly restricted, animal detection tool can play an important role in such areas. In this work, the performance of different image features and classification algorithms in animal detection application, and design a real-time animal detection system following criteria in terms of accuracy, time and cost of computation is explored. To follow these qualities, detection process is done in two levels. In first level, bulb detection process is used to subtract background from the image and this image is used in second stage for finding the region of the object using regionpropos algorithm. To examine the animal detection system, we created our own dataset, this dataset can be updated according to the application or use. The result of the approach shows that we can successfully detect the animal when it comes in a particular background.

Keywords:- *Background Subtraction for Animal Detection, Animal Detection using Digital Image Processing, Animal Detection using Matlab, Animal Detection Algorithms, Animal Detection Code*

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I. INTRODUCTION

1.1 Introduction of Image processing

Image processing is a technique where the data is represented perceptibly and processed after analyzing to get worthwhile me results. In image processing the input image is processed with employ and an environ output image is outcome. Through image processing techniques the blear or vanished images can be environ, data can be excerpt from satellite image, objects can be admitted in camera images etc. Image processing tools have property to elucidate numeric information into perceptible images that can be filtered, environ, animated, or edited in order to divulge link i.e. in past was not illusive.

In image processing an input image is contributed for data and a number of mathematical processes are implemented on the data and the result of these operations will be desired results in the form of image or numeric tables or graphs [1].

These three basic steps are included in the Image processing:

- Image accretion tools can be used for constructing the Image.
- Considering and employing the image.
- An altered image can be generated as an output or reports/data that is based on image analysis.

Components of image processing system

1. **Image Sensors**
- Physical equipment that sense energy radiated by any object.
- Digitizer is a equipment that can change output of physical equipment in digital form.

2. **Particular Image Processing Hardware**
- Specialized Image methods Hardware generally consist of the digitizers and hardware that performs other important operations, none as arithmetic logic unit (ALU). Speed is the part in this process (30 frames /sec).

3. **Specialized Image Processing Software**
- Specialized Image method Software Specialized Image method Software is specialized modules that perform specific tasks.

4. **Computer**: Computer: Image method system: from computer to a supercomputer.
5. **Mass Storage ability**:
- It should be important to used image method applications (image size of 1024x1024 pixels, with intensity level for each pixel : 8 bits, requires one Megabyte for saving)
- **Mass Storage categories:**
  - Short-term storage should be used timing methods.
  - Real time storage for accurately fast operations.
  - Factual storage for limited access.

6. **Image Displays Image Displays**: Flat screen TV sensor.
7. **Hardcop**y: Hardcopy: equipment for archives images: film cameras, laser printers, CD-ROM disk, others equipments.
8. **Networking**: the key framework is the bandwidth.

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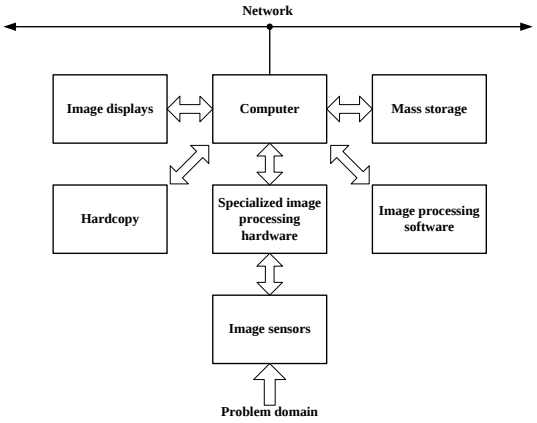


Figure: Digital Image Processing Components

Image Processing Techniques

1. Point Operations: map each input pixel to an output pixel eminence according to an eminence revolution. A simple linear point operation which elevation the input gray level $f(m,n)$ to an output gray level $g(m,n)$ is given by:

$$g(m,n) = af(m,n) + b$$

Where a and b are designate to achieve a desired magnitude deviation in the image. Note that the output $g(m,n)$ here bank on the input $f(m,n)$ at m,n.

2. Local Operations: determine the output pixel magnitude as some function of almost small neighborhood of input pixels in the district of the output location. A general linear operator can be defined as weighted of image components within a local neighborhood N.

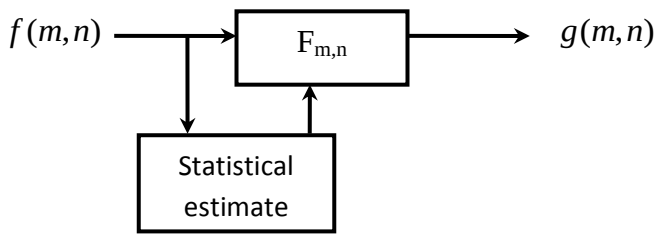
$$g(m,n) = \sum_{k,l \in N} a_{k,l} f(m-k, n-l)$$

Simple local smoothing (for noise reduction) and sharpening (for deploring or edge enhancement) operators can be both linear and non-linear.

3. Global Operations: the outputs depend on all input pixels values. If linear, global operators can be expressed using two-dimensional convolution

$$g(m,n) = f(m,n) * h(m,n) = \sum_{k,l \in N} h(k,l) f(m-k, n-l)$$

4. Adaptive Filters: This type of filter responds according to the input (this case image is input).



5. Non-Linear Filters:
   - Median/order statistics
   - Non-linear local operations
   - Homomorphism filters

Application of Digital Image Processing

A large field of latest signal technologies have became by digital image processing. Its applications pass far besides very easy aesthetical cogitation aesthetical, television, Medical imagery and multimedia signals, portable digital devices, security, video compression, and even digital movies are included by this device. Still we are observing over little simple conceit in image method but there is yet a lot more are there to study.

1) **Video processing**
2) **Machine/Robot vision**
3) **Color processing**
4) **Medical Image Processing:**
5) **Remote sensing**
6) **Pattern recognition:**

II. PROPOSED APPROACH

Many real life applications are used by animal detection. Animal detection is useful to protect human being from wild animal in residential area. Animal detection is also helpful in metro cities wherever presence of any animal warns by signal. The accidents occurring in the residential area and roads is becoming an important issue in which animal detection plays an important role. There are various methods available to detect object using background subtraction method. We can observe about various method and properties literature. It can be seen clearly that algorithms are selected according to the accuracy, cost and time. In this application we need the low cost, marginal accuracy and fast algorithm is needed. So we have selected the basic method called as bulb detection technique for animal detection for background subtraction which is to be claimed as first time in this type of applications.

Input Part

Face remembering system is essential to input part. Image acquisition operation is performed by this input part. Digital data for performing image-processing computations are changed by live captured images. Face detection algorithm is sent by these captured images.

Image Acquisition in Digital Image Processing

The action of retrieving an image from some source, normally a hardware-based source can be explained by image acquisition in image processing. We take any process from any source but it can be passed through it. Without an image, there is no processing is possible in image processing, therefore image acquisition is the first step in any work flow sequence of the image processing.

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The photographic images, such as of a physical scene or of the interior structure of an object is created by the image acquisition. To imply or include the processing, compression, storage, printing, and display of such image are usually assumed by the image acquisitions. A single sensor, single arrays, single strips are defined by the image acquisition. Image which we used in this it should be taken from any hardware based source. Without an image processing could not be possible.

Preprocessing

The basic principle of this algorithm is to detect animal from a given input image. First of all, acquire the image from a particular source. As in this thesis we use for reference images.

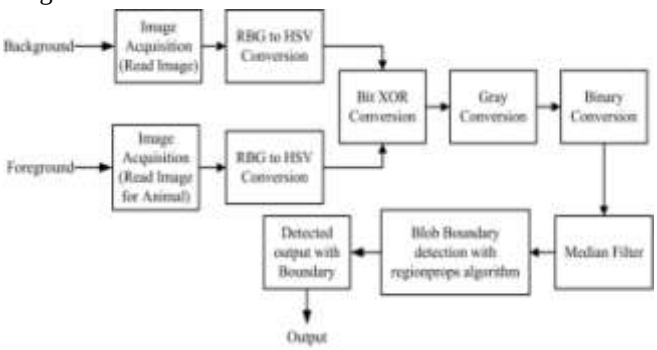

Figure 3.1: Block Diagram of animal detection using background subtraction

The following table lists all the image conversion functions in the Image Processing Toolbox

Function	Description
$dither$	Create a binary image from a grayscale intensity image by dithering; create an indexed image from an RGB image by dithering
$gray2ind$	Generally used to create indexed image using grayscale image.
$grayslice$	Generate an indexed image from a grayscale intensity image by thresholding
$im2bw$	Generally used for generating binary image using any type of image with the help of luminance threshold.
$ind2gray$	Used normally for grayscale image generation using intensity image.
$ind2rgb$	Indexed image to RGB image conversion generally used.
$mat2gray$	This process uses scaling method for converting matrix form of image into grayscale image.
$rgb2gray$	Used to convert RGB to grayscale image.
$rgb2ind$	Used to convert RGB to indexed image.

Data Validation

The process of improving the candidate foreground mask based on information obtained from outside the background model is defined by data validation. Initially, They ignore any analogue between neighboring pixels; after that the rate of modification may not match the moving speed of the foreground objects; and last non-stationary pixels from moving leaves or shadow cast by moving objects are easily mistaken as true foreground objects its three main limitation in all the background models.

Algorithm I: Pseudo code of Background Subtraction

Begin

Initialized the process for animal detection;

$I_{back} \leftarrow Imread(Background);$
$I_{current} \leftarrow Imread(Orignal);$
$I_{back}^{hsv} \leftarrow rgb2hsv(I_{back});$
$I_{current}^{hsv} \leftarrow rgb2hsv(I_{current});$
$Out \leftarrow XOR(I_{back}^{hsv}, I_{current}^{hsv});$
$[M, N] \leftarrow Size(Out);$
$for\ i = 1\ to\ M$
  $for\ j = 1\ to\ N$
    $if\ Out(i,j) > 0$
      $I_{bin} \leftarrow 1;$
    $else$
      $I_{bin} \leftarrow 0;$
    $end\ if$
$end\ for$
$I_{bin}^{filter} \leftarrow midfilt(I_{bin});$
$[L, num] \leftarrow bwlabel(I_{bin}^{filter});$
$Stats \leftarrow regionprops(L, all);$
$for\ i = 1\ to\ num$
  $dd \leftarrow Stats(i).Area;$
  $if\ dd < 500$
    $L(L == i) = 0;$
    $removed \leftarrow removed + 1;$
    $num \leftarrow num + 1;$
  $else$
    $continue;$
  $end\ if$
$end\ for$
$[L'\ num'] = bwlabel(L);$
$[B, L, N, A] = bwboundaries(L');$
$plot(result);$

III. RESULT AND DISCUSSION

Many real life applications are used by animal detection based researches. In saving crops in farm from animals are also helped by animal detection. Animal detection is useful to agriculture area wherever presence of any animal warns by signal. There are a few branches of research related to animal detection. Numerous applications have an important field Researches regarding animals in image processing. Human being has developed many algorithms and methods

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in order to have a better understanding on animal behavior. Beyond these applications can also perform as ominous system to protect people from trespass of perilous savage animal for early protection quantity. Three main branches, namely detection, tracking and identification of animal can narrow down by these applications. [44]

Data Information

This thesis work is used 5 images named animal, animal_01, animal_02, animal_03 and reference images.

Data Information

This thesis work is used 5 images named animal, animal_01, animal_02, animal_03 and reference images. From the data information available Figure 4.5 is shown as a background image used in this work for subtraction from the current frame. This background image is collect using median value from the collected images with the help of the video sequence. Video frame is captured using the DSC-W800, 20.1 MP camera. Initially, background picture is selected using camera and then video frame is captured with different available animal in the park. All video frame is captured in the day light and outdoor environment.

Next, by the observation in the video frame, images of different-2 animal are collected. Images of all animal are given in Figure 4.1 to 4.4 given below. Here, available all images are compared with the background images and animal is detected. From the available images, it can be seen clearly that background is same only object is changing in every image. From the all available images, we have selected Figure 4.1 as a base image for compare the different available method. Result of the method is described in the next section. For this type of study, data collection is most important part.

Figure 4.1: animal_01 (reference image no. 1)

Figure 4.2: animal_03 (reference image no. 2)

Figure 4.3: animal_02 (reference image no. 3)

Figure 4.4: animal (reference image no. 4)

Figure 4.5: background (reference image no. 5)

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PR and F-Measure:

To calculate the quality of the detection is checked with these two function value. PR ratio function and F-measure function which is given below:

PR Function: It is the ratio of the precision and recall function. Precision is the fraction of recovered documents that are suitable for the query and reminiscence is the fraction of the consistent documents that are successfully recovered.

$$precision = \frac{|\{relevant\ document\} \cap \{retrieved\ document\}|}{retrieved\ document}$$

$$recall = \frac{|\{relevant\ document\} \cap \{retrieved\ document\}|}{relevant\ document}$$

Value of PR is given as:

$$PR = \frac{precision}{recall}$$

Note: PR function value should be high for detection quality.

F-Measure: It is a measure, calculated with precision and recall also known as harmonic mean of precision and recall which is given as:

$$F = 2\frac{precision \cdot recall}{precision + recall}$$

Note: For high accuracy of the detection, it should be near to the 1.

IV. COMPARATIVE STUDY:

To compare the proposed method, method is compeered with the exiting method and comparison of the method can be seen in the table below. Data set is taken is the first image as a base image for comparison method.

From the Figure 4.9, it can observe that quality of the proposed method is higher than the existing method available. In the first reo of Figure 4.9 (a) is the sample frame for testing the quality of the method. Whereas rests of the all figure are the result of different-2 method applied on the sample frame. As expected, it can clearly observe that proposed method give the better detection of animal under the same light. For qualitative comparison on the sample frame given in Figure 4.9 illustrated the efficiency of the proposed method in different method and complex situation.

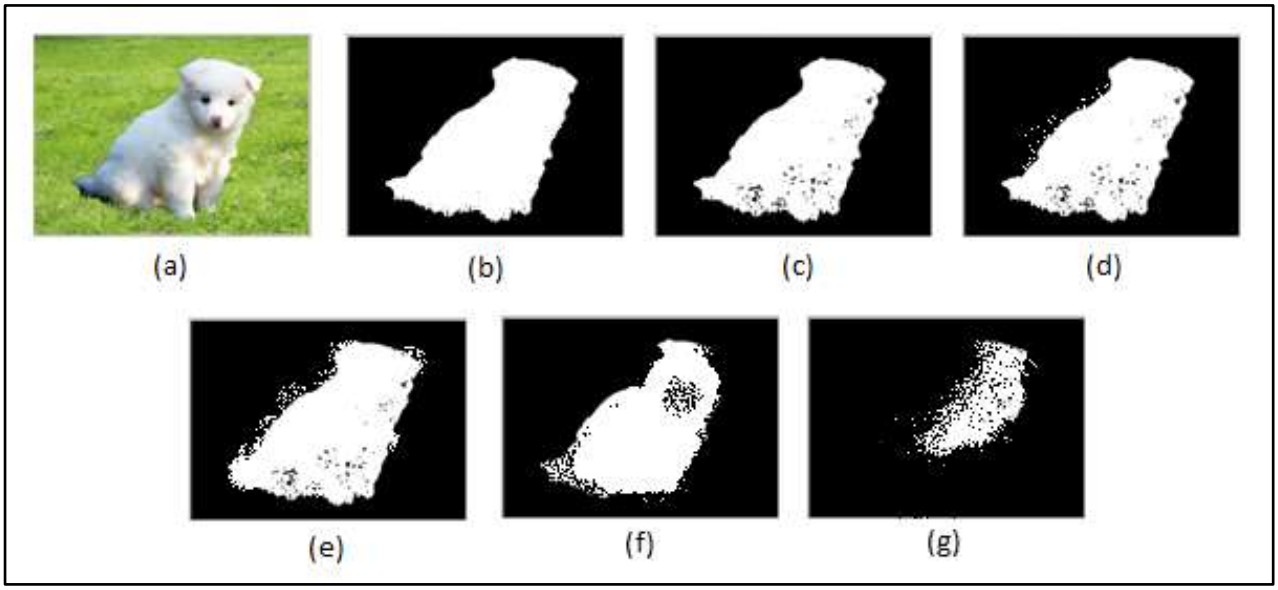

Figure 4.9: Visual comparison on background subtraction a) sample frame b) ground truth c) proposed method d) Method_2 e) Method_1 f) GMM method g) FD method

The quality of the result in quantity are evaluated using the image processing quality indicators PR ration and F- measure given in the section 4.2. This type of evaluation method depend on the evaluation metrics named as tp (true positive), tn (true negative), fp (false positive) and fn (false negative). The evaluation metrics tp and tn are used for foreground and background pixels detection, can be observed from the Table 4.1 that these metrics are correctly masseur quality of detection.

Table 4.1: Comparative study of the proposed method with existing method

S. No.	Method	PR Ratio	F-Measure
1	FD [23]	2.07438	0.002677
2	GMM [24]	7.93551	0.005112
3	Method_1 [22]	10.0101	0.009872

4	Method_2 [21]	11.0327	0.010594
5	Proposed	11.3226	0.011988

Here, table 4.1 presents the quality of detection using PR ratio and F-measure of a sampling image through proposed method and other existing methods.

Here, quality of detection in numeric form can be observed in Table 4.2. Observation of the quality is done with the help of PR ratio and F-measure value given in the table. In the table, can be seen that PR ratio and F-measure values are arranged in decreasing order which shows the quality of detection is decreasing. With application of proposed technique, results shows that the quality of 1st example is 23%, 68% and 70% higher compare to example 2nd, 3rd and 4th using F-Measure. Whereas, using PR ratio this quality is 22%, 30% and 50% approximately higher than the example 2nd, 3rd and 4th. From this table, it is clear that quality is proportional to the complexity of the image for detection.

Table 4.2: Result of the proposed method on the different objects

Animal Image Name	Background Detection	Animal Blob Detection	PR	F-Measure
Animal	✔	✔	11.3226	0.011988
Animal_01	✔	✔	8.6381	0.0087666
Animal_02	✔	✔	7.715	0.0038088
Animal_03	✔	✔	5.6932	0.0036146

Note: Maximum value of PR is infinity and maximum value of F-Measure is 1.

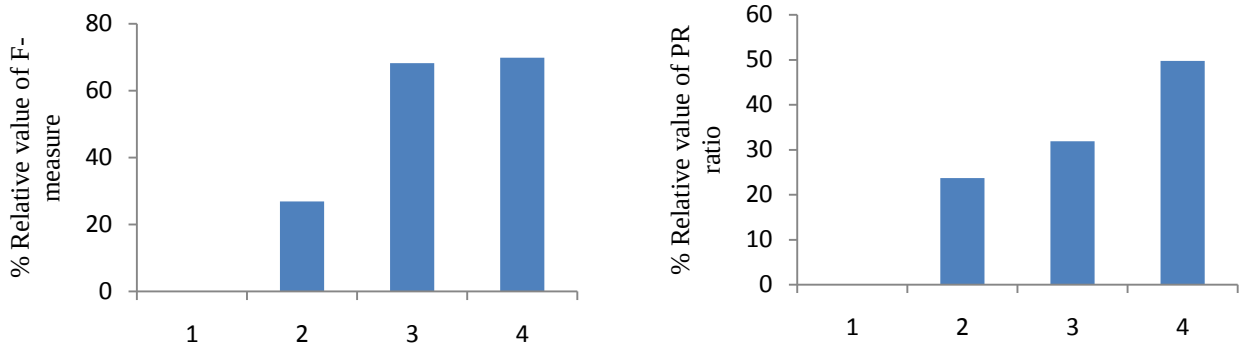

Figure 4.14: Relative study of PR and F-measure with base image as 1st example

V. CONCLUSION

Animal detection plays an important role in real life applications problem handling. These animal detection system and warning system have used to detect or indicate particular animal for an objective. For our problem, we have used this system for protection purpose.

In this work, background subtraction method is used for detecting the animal. For implementation of this proposed method we have used regionprops algorithm. This particular technique is used to separate the object from the image. Whereas, object shaping is identified using blob method. This method is general and fastest technique in machine vision used for identifying the image region. It is a combination of various methods for special application where we need **to** separate object from the background. This proposed method is compared with existing technique and result shows that proposed method performs outstanding for this type of images. Also, we have applied this method on four different images and result shows the detection of animal is possible with this technique.

We design an automatic system in which animal can detect when it come in particular background. The result of the approach shows that we can successfully detect the animal in particular background.

VI. FUTURE SCOPE

- This approach works on static image. But this will not work on moving video so it is a future

enhancement to design a system which works also on moving videos.

- In the future we can also work on energy consumption and time efficiency.
- This type of method can be used in medical field for identifying the cause of illness.
- Efficiency of this method can be checked on various applications.

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