International Journal of Modern Electronics and Communication Engineering (IJMECE) ISSN: 2321-2152
Volume No.-7, Issue No.-1, January, 2019

Template Matching using correlation of two images

Milind Sutar1st
Department of Electronics Engineering
Vishwakarma Institute of Technology
Pune, India
E-mail:milind.sutar16@vit.edu

Shrinath Dhote2nd
Department of Electronics Engineering
Vishwakarma Institute of Technology
Pune, India
E-mail: shrinath.dhote17@vit.edu

Milind Rane3rd
Department of Electronics Engineering
Vishwakarma Institute of Technology
Pune, India
E-mail: milind.rane@vit.edu

Abstract: Template matching is one of the major problems and has been widely used in tracking, extracting, recognition and many other applications. Recently, Template matching approach has been widely used for much area to find out valuable information. Template matching answers to most basic questions about an image? Is there a certain object in given image and where it is. The template is a description of that object hence is an image itself and is used to search the image by computing a difference measure between the template and all possible areas of the image that could match the template. In this paper method of normalized cross- correlation (NCC) of two images is used match a given template in target image. Algorithm for the process and technique is discussed in paper.

Keywords: Image correlation, Pattern Matching, Template, Template matching, normalized cross-correlation.

I. INTRODUCTION

Template matching is a technique in computer vision and digital image processing for matching small parts of an image that matches a given template image. Templates are usually used to identify characters, and other small objects. It can also be used for detection of edges in figures .This method can be easily used on grey or edge images. It can be used for various applications such as detection of part of image and where exactly it is in the image. To perform this process on given image we should perform necessary operation on image first to enhance the image such as – rgb2gray function. And by understanding the size of the image we can perform correlation operation on the images. Image correlation and matching is an optical method that performs matching and image registration techniques for correct 2D and 3D measurements of changes in images. Digital image correlation techniques popularly used nowadays, mainly in micro and Nano-scale mechanical testing applications due to its ease of implementation and use. Technologies for this process and while white-light optics has been the predominant approach, DIC can be and has been extended to almost all imaging technology. The process of using cross-correlation to measure changes and shifts in database has been known for a long time, and it has been applied to digital images. Target image (I): The image in which we want to find a given template image. Template image (T): It is a patch or part of image we want to locate in target image. Template Matching is a method for discovering zones of an image which matches (are indistinguishable) a target image (patch).

Fig.1:Example of Template from a Image.

1.1 Template Matching Approaches

General categorizations of template matching approaches are Featured-based approach and Template or Area based approach.

1.1.1 *Featured-based approach:-* The Featured-based concept is more appropriate while both target and template images have more connection with features and control points. The features comprises of points, a surface model which we are interested in matching.

1.1.2 *Area-based approach:* - The Area-based methods are referred to as correlation like methods or template finding methods, that is the blend of feature matching - detection , motion tracking etc. Area-based methods merge the matching template part with the feature detection step. These methods manage the image without attempting to identify the remarkable article. Known predefined sizes are used for the calculation of correspondence.

1.1.3 *Template-based approach:* - Template-based template matching technique may require sampling of a huge quantity of points; it is possible to cut back the amount of sampling points by downsizing the resolution of the target and template images with the same factor and performs operation on resulting diminished images.

1.1.4*Motion Tracking and Occlusion Handling:*- For the template which can't provide and may not provide a instantaneous match, in that case Eigen spaces may be used , which provides the details of matching image beneath numerous conditions, appropriate matching poses or color contrast.

II. LITERATURE SURVEY

Template Matching is a high-level computer vision technique that identifies the parts on an image that match a predefined template. Advanced template matching technique allow to find occurrences of the template regardless of their orientation and local brightness.Template Matching techniques are flexible and relatively straightforward to use, which makes them one of the most popular methods of object localization. Their applicability is limited mostly by the available computational power, as identification of big and complex templates can be time-consuming [1].Template matching is the one of the measure application in field of computer vision. Templates are not scale or rotation invariant, means any change in this two factor in template image may result no matching in target image. Even small shift in orientation or size variations can cause problems. various techniques are proposed till date for this purpose such as: - i) Sum of Absolute Difference, ii) Sum of Squared Difference, iii) Normalized Cross Correlation, iv) Cross Correlation[2]. Before we perform any operation on image pre-processing of the images should be done in order to remove noise and dissimilarities from image. Image processing: - An image is an array, of square pixels (picture elements) arranged in rows and colums. In (8-bit) grey scale image each picture element has an assigned intensity that ranges from 0 to 255. A gray scale image is what people call a black and white image, but the name explaines that such an image will also include many shades of gray. To perform template matching technique on a image , first converting it to a binary image also helps in process. A binary image is a image that has only two possible values for each pixel. The two colors used for a binary image are white and black. The color used for the object(s) in the image is the foreground color where the rest of the image is the background color [3]. In the document-scanning industry, this is also called to as "bi-tonal". Based on this some other techniques are also present in template matching such as i)*Grayscale-based Matching:* - In some of the applications the orientation of the objects is uniform and fixed, it is often the case that the objects that to be detected are appear rotated. In In Template Matching algorithms the classic pyramid search is adapted to allow multi-angle matching, i.e. identification of rotated insatance of the template. This is achieved by computing not just single template image pyramid, but a set of pyramids - one for each possible rotation of the template. During the pyramid search on the input image the technique matches the pairs rather than sole template positions. Similarly to the original scheme, on each level of the search the algorithm verifies only those pairs that scored well on the previous level. ii)*Edge-based Matching:* - Edge-based Matching enhances the earlier discussed Grayscale-based Matching using crucial observation - that the shape of any object is defined mainly by its edges. Therefore, instead of matching of the whole template in target image, we could extract its edges and match only the nearby pixels in target image , it allows avoiding some unnecessary computations. In common applications this achieved speed-up is greatly significant.

2.1 Present Template matching applications*:*-

2.1.1. *Object Recognition using Template Matching: -*
Object recognition is job of discovering a known item inside a target image or video sequence. Object recognition used to properly identify objects in a scene and estimate their location and orientation. The purpose is to understand the capacity of existing object recognition methods to search out similar objects once input is completely of image type. We would like to rearrange these objects that are visible to us. These objects are totally visible or partly hidden behind another object in target image. Similar objects might also be available in the various orientations. The identification of those objects is easy for human eyes being as he can easily identify any object based on his knowledge or experience yet it is much hard to distinguish a specific item for a machine or computer. The machine has to learn how to recognize any object in the image. For this purpose, certain algorithms are proposed. With the assistance of those algorithms and techniques, a machine will understand objects present in the various orientation, camera parameters, lightning conditions, appearance etc. For instance, the writing style of two individuals is totally different than each other. But two people can compose one letter with varied designs [4].

2.1.2. Biological area: -
It is used in biological science such as Molecular Biology and Nuclear Agriculture. It consist applications that involve the use of digital camera-based hardware systems or coloured scanners for inputting pictures. The software package that's has been designed for such cause is the BIAS software that supports windows and DOS friendly Colour-Pro software which is developed in Electronics Systems Division and Comprehensive digital Image method. It has the following features like colour image analysis for evaluation of leaf, chlorophyll and defected leaf areas. For plant breeding estimation of leaves area was extremely required. In olden days, leaf area meters are used for this process. However nowadays image analysis is used for measurement of leaf area and it is very efficient. The image of leafs are initially taken via digital camera or a scanner and so analysed by the Colour Pro software package designed via Electronics Systems Division. A range of colour plates and chlorophyll meters was earlier used to examine chlorophyll substance of leaf inside situ [5].

2.1.3. Eye Detection in a Facial Image: -
In this application, we are provided with an eye template and a target face image .Then we find the correlation of an eye template through the overlapping areas of the target face image, the section that offers the maximum correlation

coefficient with the given eye template is referred to as eye region, this is how eye is found out in target face images.

2.1.4. *Remote Sensing*: -

Remote Sensing may be used at precise wavelengths at the same time to give thousands of digital images. Its knowledge can be gathered from a hyper spectral devices contains not only the visible spectrum however it contains both infrared ranges and ultraviolet. It's normal to list the hyper-spectral data in a 3-D array, with the first 2-D matching with geographical dimensions and therefore the third one is similar to the spectrum. During hyper spectral categorization and particularly in target detection, the most important purpose is to seek out spatial pixels in 3-D hyper spectral cube data for a few best known template spectral signals of interest in dataset. Though, it becomes complicated because of its variability and uncertainty of every material's spectral signature. These difficulties also comprises of noise from atmospherically conditions, location, illumination and sensor control etc., all of that rely on once and wherever the image was taken[6][7][8] .

III. PROPOSED WORK

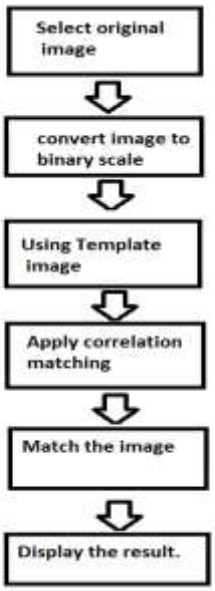


Fig 2: Flow Diagram of Template Matching approach.

3.1 Algorithm explained from Fig.2*:* -

1. First select the Target image: - The image will be in different file formats such as JPEG/JPG PNG etc.
2. Convert to Binary Image: - The technique to converting the color image into black and white image is named as a binary image. This process is based totally on number of color transforms. It analyzes the values of grey scales of image and achieves it according to the R, G, B value within the image.
3. Using the template image: - Template image is a small patch/part of a target image and is used to match the template within the given target image.
4. Apply Template Matching Correlation Technique on image.
5. Then match the images with the target image. And then plot box around matched part in image.
6. Display the result.

3.2 Image Correlation Matching

The numeric measure between two image similarities is called as image-correlation. Cross correlation with a filter can be viewed as comparing a template "picture" of what you want to find against all local regions in the target image.

*Normalized cross-correlation:-*Normalized cross-correlation is an advanced method of the traditional cross-correlation process. Which brings two improvements:- i) The outputs are constant to the global brightness changes such as darkening of whichever figure or constant brightening have no impact on end result. ii) The final correlation value is scaled to [-1, 1] range[4][11].

$$\frac{1}{N\sigma 1\sigma 2\sigma}\sum_{u,v}[(\mathbf{Image1}(u,v)-\overline{\mathbf{Image1}})*(\mathbf{Image2}(u,v)-\overline{\mathbf{Image2}})]$$

Equation.1: Formula for normal cross-correlation.

In Equation.1, two images been taken Image1 and Image2 and their pixel co-ordinates (u, v) and σ is constant. Pixel co-ordinates of the images are bounded in the size of the image. Normalized cross-correlation can be applied as an effective resemblance measure meant for matching and detection applications. But, traditional correlation-based image matching methods may not succeed when there are significant scale shifts or large rotations among the two images [4].Normalized cross-correlation method is used in face recognition system. Normalized Cross Correlation is the technique that is employed in image registration for matching the template with an target image. On the other hand, NCC also influenced by factors such as illumination and clutter background issues[9]. In case of Normalized cross-correlation, there's a greater increase within the inaccuracy rate which is because of the shaded input images.

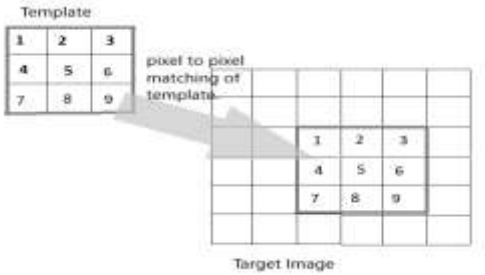


Fig 3: Normalized cross-correlation matching.

From fig.3 it is clear that algorithm used for normalized cross-correlation template matching is continuously operate in iterations till each and every pixel of template matches to the every pixel of that template in target image. At end of this process we will have the location of template in target image. After this we can perform other MATLAB functions to plot a

box around the matched template in target image , to distinguish it clearly .With Normalized cross-correlation estimation becomes quite good with big dataset. Template matching is the most effective technique to be used in detection and pattern recognition machines which read letters and numbers that are available in standardized contexts. Easy and less-complex technique compared to other methods [10].

IV. RESULT

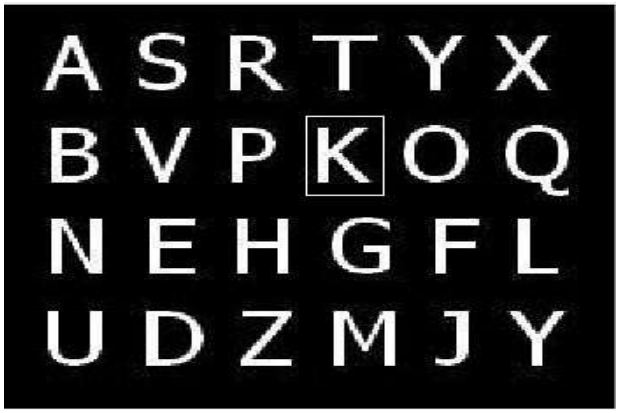
Template matching algorithm is performed in MATLAB 2016, with alphabets data-set. Templates are the cropped images of the alphabet data-set, on which Normalized cross-correlation algorithm is applied. Operations are performed on images in MATLAB GUI and result images are shown in Fig.3 and discussed below.

i) Target image

*ii) Template **M**.*

*iii) Template **K**.*

iv*) Matched Template **M**.*

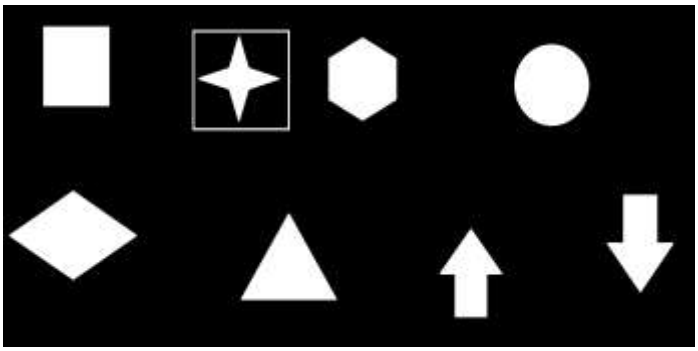


v) *Matched Template **K**.*

Fig.4: Resul_1 t images from MATLAB GUI.

After applying normalized cross-correlation on template and target image we have result shown in Fig.3, which represent the exact position of the template (patch) in the target image. In Fig.4 i) is target image, ii) and iii) are the templates cropped from target image. iv) & v) are the matched template result for template ii) and iii) in Fig.4. The boundary of square box is plotted around matched template for better understanding of the user. Same algorithm of Normalized cross-correlation is performed on another binary image of different shapes. Result of this process is shown in Fig.5.

i) Template



ii) Target image

Fig.5:- Result_2 on MATLAB GUI.

V. CONCLUSION

Template matching covers a wide scope in enormous multiple regions in image processing. This paper defines how normalized cross- correlation technique can be used for template matching and pattern matching in given target image. We discussed different approaches of template matching in

image processing in brief. And then various techniques proposed till date. We discussed the normalized cross-correlation technique for template matching in detail and its advantage over other traditional techniques. Since this is the less complex and easiest way of template matching it comes with various limitations. With large dataset this technique may be time consuming but at the it is an easy and effective way. Proposed system is just used to seek out specific character, shape and part from certain image, if it comes to relate with color the proposed system will not work. For image with many edges, edge detector rule would possibly consume longer time to convert into binary image, this reflects on total time taken, and machine won't offer output in desired time period. In near time first step will be to implement this proposed system on real world scenario with the use of graphics boards. Afterwards if required, noisy images may be handled, as effects this shows that, with the increase of noise, the efficiency of system decreases.

REFERENCES

[1]Aksoy, M. S., O. Torkul, and I. H. Cedimoglu. "An industrial visual inspection system that uses inductive learning."Journal of Intelligent Manufacturing 15.4 (August 2004): 569(6). Expanded Academic ASAP. Thomson Gale.

[2]Kyriacou, Theocharis, Guido Bugmann, and Stanislao Lauria. "Vision-based urban navigation procedures for verbally instructed robots." Robotics and Autonomous Systems 51.1 (April 30, 2005): 69-80. Expanded Academic ASAP. Thomson Gale P. Kopyt et al., "Electric properties of graphene-based conductive layers from DC up to terahertz

[3]Nilamani Bhoi,Mihir Narayan Mohanty. "Template Matching based Eye Detection in Facial Image".International Journal of Computer Applications (0975-8887) Volume 12-No.5,December 2010.

[4]Paridhi Swaroop , Neelam Sharma , " An Overview of VariousTemplate Matching Methodologies in Image Processing" , international Journal of Computer Applications (0975 – 8887) Volume 153 – No 10, November 2016

[5]Feng Zhao, Qingming Huang, Wen Gao "IMAGE MATCHING BY NORMALIZED CROSS-CORRELATION" , researchgate.net

[6] Ms. A.Sakila,Dr. S.Vijayarani. "Template Matching Technique For Searching Words In Document Images". International Journal on Cybernetics & Informatics (IJCI) Vol. 4, No. 6, December 2015.

[7] P. E. Anuta, "Spatial registration of multispectral and multitemporal digital imagery using fast Fourier transform techniques", IEEE Trans. Geosci. Electron., vol. GE-8, p. 353–368, Oct. 1970

[8] Nazil Perveen, 2Darshan Kumar and 3 Ishan Bhardwaj , "An Overview on Template Matching Methodologies and its Applications" International Journal of Research in Computer and Communication Technology, Vol 2, Issue 10, October-2013

[9] Er. Priyanka Jarial, Amanpreet Kaur. "Object Recognition using Template matching with the help of Features extraction method". International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 02 Issue: 05 | Aug-2015.

[10] Ms. A.Sakila,Dr. S.Vijayarani. "Template Matching Technique For Searching Words In Document Images". International Journal on Cybernetics & Informatics (IJCI) Vol. 4, No. 6, December 2015.

[11] Preeti Tuli, Kavita Ahuja. "Object Recognition by Template Matching Using Correlations and Phase Angle Method" .International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 3, March 2013.

Author's Biographies

Milind Sutaris a student of ElectronicsTechnology, from Vishwakamra Instituteof Technology, Pune. He is currently Pursuing B-tech degree in Electronics.

Shrinath Dhoteis a student of ElectronicsTechnology, from Vishwakamra Instituteof Technology, Pune. He is currently Pursuing B-tech degree in Electronics.

Milind Rane isanprofessor for Computer Vision in Electronics Department in Vishwakarma Institute of Technology, Pune.