Abstract: Target identification process leads to identify a specific object or target. There is huge amount of objects at the nature, and some of these objects have similar characteristics but others are different. The main aim of this work is to design an efficient approach for object or target identification. The implemented approach tries to overcome the challenges that appear during the processing. This approach is implemented via many steps; preprocessing, feature extraction, invariant features, classes calculation then comparison the obtained results to decide the nearest distance of the specific object with the existing image database. The obtained results indicated that high performance of identification is achieved via the application of this approach. Three oriented images are tested 0-degree, 90-degree and 180-degree, in all these images, the obtained similarity is about 99%.

Keywords: Object Identification; Object Recognition; Moments; Feature Vectors; Digital Image Processing.

1. Introduction

Every day, each person receives, processes, and analyzes a huge amount of information of various kind, significance and quality and has to make decisions based on this analysis [1,2,3]. Image is a very powerful information medium and communication tool capable of representing complex scenes and processes in a compact and efficient way [4,5,6]. Biometrics becomes a wide area of applications in both physiological and behavioral characteristics [7,8,9]. Biometric recognition and identification concentrated on human security issue such field concerns with the object or target identification [10,11,12].

In the nature images are represented in analog form, and the processing of these images can be performed by analog image processing systems that are found for more than 100 years [13,14,15]. Digital image processing is a recent approaches of image processing that has wide range of applications in both time domain and frequency domain in digital values [16,17,18]. Digital image processing can be simply represented as a two dimensional matrix, and each element of the matrix represents the pixel value which is the intensity of that point and it is represented by 8 bits for gray scale image [19,20,21]. In addition, the more advanced image processing systems are color image processing system, the element in color image is represented by 24 bits or three bytes; first byte for red color, second byte for green color, and the third byte is for blue color [22,23,24].

The simple structure of digital image processing system is shown in figure 1 [25,26]. The first stage of image processing system is converting the analog image data into digital form to be presented in the next stage [27,28,29]. The second stage is preprocessing that reduces noise and unwanted data [30,31]. The third stage is the heart of the system that includes the digital image processing part [32,33]. Then lastly display the output after converting the data into analog form to see the operation that implemented on the image [34,35,36].

Type of the Paper (Article)
Pattern recognition is an important issue in digital image processing that concerns of a set of processing’s to recognize a certain pattern of a specific object [37,38,39]. Pattern recognition is the main part of target identification [40,41]. This approach tries to illustrate a certain step to specify and identify a specific object [42,43].

![Digital Image Processing System](image)

**Figure 1.** Digital image processing system

### 2. Target Identification

Human eyes can identify persons, animals, faces, signatures, and any other object, considering that the pattern of the specific object is stored in his brain [44,45,46]. Target identification is an important area of image processing that depends on the extracted features from a specified image [47,48,49]. Feature extraction is an important step in target recognition and identification in which you can detect the characteristics of the object [50,51,52,53]. Feature extraction operation can be implemented by applying discrete Fourier transform (DFT), discrete cosine transform (DCT), discrete wavelet transform (DWT), support vector machine (SVM), moment vector (MV) … etc [54,55,56,57].

Target identification process can be achieved after many stages that applied to the original image (figure 2) [58,59,60]. First stage is preprocessing in which the original image is filtered and resized [61,62,63]. Second stage is detection in which detect the specified object through many other objects [64,65,66]. Third stage recognition in which recognized the detected object according to its characteristics [67,68,69]. Fourth stage categorization in which categorized the objects into groups [70,71,72]. So lastly it is possible to decide the type to identify the object [73,74,75].

![Target Identification Process](image)

**Figure 2.** Identification process
3. Literature Reviews

The field of target identification is a huge area; in addition, it is including many subfields. So to specify this issue it is important to restrict the search to be limited to updated published papers.

Chih-Yang Lin et al. (2013) proposed object identification based on the multi-camera environment to adapt to real cases. This model is represented by two hierarchical structures that are responsible for information about color and texture, respectively, where each layer of a tree is maintained by a Gaussian mixture model. The identification process is carried out with a delicate voting system without complicated calculations to satisfy the demands of the applications in real time. Experimental results show that this unique aspect model is robust for translation, rotation, scaling and shape variations. In addition, it is equipped with an automatic model update, and achieves a high accuracy rate and high throughput [76].

Hao Ding et al. (2013) proposed three stage approach to the identification of the object of the autonomous space based on optical images. First, on the basis of the approximate model of perspective images, a scale descriptor and invariant illumination, composed of standardized instantaneous invariant and the inverse multi-scalar auto-convolution transform, is developed to characterize the spatial object. Secondly, a multi-view modeling method is applied to create spatial object databases of several views to manage the change of viewpoint. Finally, given the extensibility of the databases, they used a classifier closest to K and adopt a cluster of K-means to increase the search speed. In addition, to test performance, a new system based on the proposed approach is constructed and evaluated. Experimental evidence suggested that the system is stable and works well when a space object’s scale, phase angle, and point of view change [77].

Yuanjin Xu et al. (2014) used the spectrum of a field object to match the spectrum of pixels in the hyperspectral images and to determine if there was a dominant object in the pixel and to what extent the dominant object was present. Based on these recognition results, altered rock was identified in the formation of hyperspectral images. The spectrum of a field object was obtained from the field surveys in the study area, and in the spectrum there was only one main object that could be effectively identified; this main object was named the dominant object. The overall shape of the spectrum was first correlated and then the correlation coefficients between the pixel spectrum and the field object spectrum at the corresponding wavelength ranges of the absorption bands were calculated to determine the matching effect of these spectra, as well as the possibility that the dominant object existed in the pixel [78].

Li-Hong Juang et al. (2014) explained that in order to detect the object from a complex background, the variations of lighting and texture by machine are very difficult but important for the adaptive information service. They presented a preliminary design and recognition results of experimental objects of a mobile device that uses texture and color characteristics by pre-processing of images with a classifier of distance of simple vectorial distance to form and to extract the characteristics. The result showed that the proposed method can adopt the few characteristic values and that the accuracy can reach up to 100% of the identification rate of the object during the consultation of a mobile phone. The Euclidean distance is also used to represent the similarity of objects. The similarity can reach 87.5%, 62.5%, 75% and 87.5%, respectively [79].

Stephen J. Gotts (2015) discussed that the recent experience in object identification leads to further improvements in speed and precision as well as simultaneous reductions in neuronal activity. They tested this hypothesis in an fMRI adaptation experiment using object images, in which participants repeatedly named a set of object images. During fMRI, participants saw adaptation sequences consisting of rapidly repeated objects (3-6 repetitions in several seconds) that were previously named or were new to the fMRI session, followed by images of isolated deviated objects used to measure recovery of adaptation and that they shared a relation with the adapted image. The effects of adaptation and recovery were observed in all visually reactive regions of the brain. They suggested that alternative mechanisms, such as increased neural synchronization, are more promising to explain the onset of suppression of repetition [80].

Geneviève Desmarais et al. (2015) identified each pair of objects and actions with labels that generated a visual or semantic form of action and varied the congruence between label information
and visual form or action of new objects. The participants named objects and they produced the action associated with objects. Congruent tags have generally facilitated performance. In addition, for participants who learned incongruent associations, the visual form and the semantic information generated by the labels influenced performance in opposing models. These results support the notion that naming may be necessary before actions occur when object / action associations are new. The obtained results confirm the idea that the links between the structural properties of objects and their actions can already be stronger than the links between verbal labels and actions in the new object / action associations [81].

Ewa Pluciennicka et al. (2016) evaluated the development of implicit processing of three types of semantic relationships by identifying manipulable artifacts. Thirteen adults and thirty-nine children participated in this work. Temporal fixation dynamics were used to assess the effects of competition on thematic distortions, specific function and general function. The effects of competition were analyzed according to the type of distraction and the age group. Development results demonstrated the emergence of competing effects with general functional distractors with age, while the effects of competition with the subject and the specific functional distractions were stable for age 6. The results show a development to capitalize on the implicit use of the semantic mechanism based on similarity during object treatment from age 6. They also suggest that the mechanism based on complementarity is used effectively during the semantic processing of the object from age 6 and probably involved in the processing of the thematic and specific functional relationships [82].

Dong Zhang et al. (2016) proposed an object recognition algorithm to automatically identify fish species. The previous work concerned on general object recognition, called evolution constructed functionality, has been modified and adapted to create functionality and use AdaBoost to classify different species of fish. The proposed algorithm does not rely on human experts to design features for the classification of fish species, but constructs efficient features automatically. The results of the experiments show that the proposed method has obtained an average classification accuracy of 98.9% with a standard deviation of 0.96% with a data set consisting of 8 fish species and a total of 1049 images. Using this algorithm, a fish monitoring system can be constructed to eliminate invasive species and monitor the abundance, distribution and size of native fish with minimal collateral impact and fish suffering [83].

Min-Suk Kang (2017) studied the ability of participants to inhibit eye movements when they had to treat a peripheral target with the obligation to maintain a strict fixation. An eight-letter table consisting of four characters was briefly presented and a directional marker was presented centrally to indicate the location of the target. The stimulation initiation asynchrony (SOA) between the signal and the stimulus table was selected from six values, consisting of pre-cue conditions (-400 and -200 ms), a simultaneous (0 ms) and post- signals (200, 400 and 800 ms). These results indicate that the inhibitory process that controls ocular movements also competes for cognitive resources like other cognitive processes [84].

Marcos Escudero-Viñolo, Jesus Bescos (2017) described a strategy based on regions for the partial identification of objects with the independence of external factors that affect the captured image: variations of light, capture of point of view or occlusions. This approach focused on the identification of objects acquired in scenarios of severe occlusion. To deal with this problem, they assumed that the objects were previously separated from the scene. Significant changes in appearance, due to one or more of the above factors or to the nature of the object, as deformable objects, considerably increase the complexity of the problem. The proposed algorithm operates by dividing separate objects into partitions of successively thicker regions, each region representing a portion of the object from which it was extracted [85].

Jin Wang et al. (2018) presented an algorithm to learn a distance of Mahalanobis for the re-identification of people. This method has two distinctive features: first to obtain the best separability of training data, and second to promote the generalized capacity of the metric learned, then maximize the minimum margin between different classes. Inspired by simple geometric intuition that a normal simplex maximizes its minimum lateral length, as long as the sum of the length of each side is fixed, this method, called Equi-Distance constrained Metric Learning. This method applies a least squares
regression technique to assign images of people identical to the same vertex of a regular simplex, and images of different people at different vertices of a simple regular. Consequently, under the educated metric, images of the same class collapse into a single point, while images of different classes are transformed into equidistance [86].

Rinku Datta Rakshit (2018) reported on a facial recognition visible system for surgery face image using new variants that are exploited from the local graph structure. The proposed approach variants are attempting to improve the performance of the facial identification system under the influence of changes in posture, expression of facial changes, lighting changes, makeup, accessories and face complexity. This approach represented each pixel with its neighborhood pixels of a face image as a function of the regenerated directed local graph structure. At this approach, a binary pattern is generated for each pixel and this bit string is then converted to a decimal value and generates a converted pattern. Finally, the converted pattern was used to generate a concatenated histogram then used to match and identify using three known classifiers, namely a local sum of squared differences, an amount for local absolute differences and the intersection of the histogram [87].

4. Methodology

The methodology of this approach is concentrated on many parts including preparing image dataset of digital images with different position angle, explain the moment method of identification, the overall design of the system.

4.1. Image Dataset

Various types of digital images are prepared with different positions. These images are cleaned and preprocessed to be suitable for the processing via the implemented approach (figure 3).

![Images with different positions](image)

**Figure 3.** Images with different positions

4.2. Moment Calculation

In image processing, computer vision and related fields, an image moment is denoted as a certain weighted average of the intensities of the image pixels, or a function of those moments, generally chosen to have a property or an attractive interpretation. The continuous moment function is given by:

\[
m_{pq} = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} x^p y^q \rho(x,y) \, dx \, dy
\]

where \( \rho(x,y) \) is the projection of image to basis \( x^p y^q \) and \( p,q = 0,1,2,\ldots \)

Then the raw moments is given by:
\[ m_{pq} = \sum_{x} \sum_{y} x^p y^q f(x,y) \]  
Where \( M_{00} \) is equal to area/volume, \( M_{10} \) is equal to sum over \( x \) and \( M_{01} \) is equal to sum over \( y \).

Then the centroid coordinates are given by:

\[ \bar{x} = \frac{M_{10}}{M_{00}} \quad \text{and} \quad \bar{y} = \frac{M_{01}}{M_{00}} \]  

So for the discrete sampling we have:

\[ \mu_{pq} = \sum_{x=0}^{\infty} \sum_{y=0}^{\infty} (x - \bar{x})^p (y - \bar{y})^q f(x,y) \]  
The centroid of the image \( f(x,y) \) are the pixel point \( (\bar{x}, \bar{y}) \). So the central moment \( \mu_{00} \) can be measured using the image centroid that similar to \( m_{00} \) whose center has been shifted to centroid of the image. So the normalized central moments are given as below:

\[ \eta_{pq} = \frac{\mu_{pq}}{\mu_{00}} \]  
Where \( \gamma = (p+q+2)/2 \) and \( (p+q)=2,3,4, \ldots \).

The useful characteristics of unchanged of moment invariants for image resizing, translation and rotation, so the seven moment invariant are given as below:

\[ \varphi_1 = \eta_{20} + \eta_{02} \]  
\[ \varphi_2 = (\eta_{20} - \eta_{02})^2 + 4(\eta_{11})^2 \]  
\[ \varphi_3 = (\eta_{30} - 3\eta_{12})^2 + (3\eta_{21} - \eta_{03})^2 \]  
\[ \varphi_4 = (\eta_{30} + \eta_{12})^2 + (\eta_{21} + \eta_{03})^2 \]  
\[ \varphi_5 = (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] \]  
\[ + (3\eta_{21} - \eta_{03})(\eta_{21} + \eta_{03})[3(\eta_{21} + \eta_{03})^2 - (\eta_{30} + \eta_{12})^2] \]  
\[ \Phi_6 = (\eta_{30} - \eta_{12})[(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2] \]  
\[ + 4\eta_{11}(\eta_{30} + \eta_{12})(\eta_{21} + \eta_{03}) \]  
\[ \Phi_7 = (3\eta_{21} - \eta_{03})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] \]  
\[ - (3\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2] \]  

The transformation of the geometric image is a popular technique in image processing, which usually involves the translation, scale and rotation of the image. The position of each pixel of an input image in a new position an output image in translation trace. The scale operator is used to reduce or enlarge the size of an image, which is obtained by subsampling or interpolating the input image. The rotation operator tracks the position of each pixel to a new position by rotating at a specified angle, which can generate non-integer coordinates. In order to generate the pixel intensity at each full position several interpolation methods can be used such as near neighbor interpolation, bilinear interpolation and bi-cubic interpolation.

4.3. Design of Efficient Identification Approach

Many methods are used for clustering and recognition of objects according to their features. Moment invariants are special functions of image moments so this approach is concentrated on the application of moment invariants for image identification. In this case, each view point reflects what part of the object is needed to calculate the invariant. The proposed approach of object identification including many steps as below (figure 4):

- Input image: it is a set of digital images that prepared to be processed.
- Preprocessing: many processes to be applied on images for preparing to the next step, including resizing, filtering …etc.
- Feature extraction: it is the process in which the features are extracted to achieve the characteristics of the image.
- Invariant feature: it is applied on the extracted features to perform the invariant features of the image.
- Shape classes calculation: it is applied to classify the images according to their shapes.
- Feature vector comparisons: it is a comparison process that compare the features of the new image with the feature vector.
- Output decision: it is a decision process according to the stored vector.
5. Results and Discussion

Moment invariants are deal with the generation of the characteristics of the connected regions in binary images that are invariant to translation, rotation, and scale. They define a set of simply calculated region properties that can be used to classify and recognize shapes. An image moment is a particular weighted average of the intensities of the image pixels, or a function of those moments.

Moment invariants are calculated to achieve more information about the objects. The tested images are prepared to adapt the changes in scale and rotation. Many images are tested for the same object that rotated in different positions, zero position, 90-degree position and 180-degree position as shown in figure 3. The primary step to adapt via the moment invariants processing is converting these images into gray scale images then into binary images as shown in figure 5.

Figure 6 shows the moment invariants of 2D binary images of size 256*256. Figure 6a represents the moment invariants of the original image (0 degree), figure 6b represents the moment invariants of the rotated image (90 degree) and figure 6c represents the moment invariants of the rotated image (180 degree). These curves illustrate that there is a small different between the values of moment invariants in which these data can be return back to the same object.
Figure 6. Moment invariants of 2D binary images

Figure 7 shows the mean value of moment invariants of 2D binary images of size 256×256. Figure 7a represents the mean value of moment invariants of the original image (0 degree), figure 7b represents the mean value of the moment invariants of the rotated image (90 degree) and figure 7c represents the mean value of the moment invariants of the rotated image (180 degree). These bar curves indicated the similarity between the three tested images.
a) mean value moment invariants of the 0 degree rotated image

b) mean value moment invariants of the 90 degree rotated image

c) mean value moment invariants of the 180 degree rotated image

Figure 7. Mean values of moment invariants of 2D binary images

Figure 8 shows the similarity between three different oriented images 0 degree, 90-degree and 180-degree. Figure 8a represents the similarity of mean value of moment invariants between the 0-degree image and the 90-degree oriented image, in which it is clear that there is a very small difference values ranged from zero to about 0.01 that gives a high similarity reach to 99%. Figure 8b represents the similarity of mean value of moment invariants between the 0-degree image and the
180-degree oriented image, in which it is clear that there is a very small difference values ranged from zero to about 0.00002 that gives a high similarity reach to 99.9%. Figure 8c represents the similarity of mean value of moment invariants between the 90-degree image and the 180-degree oriented image, in which it is clear that there is a very small difference values ranged from zero to about 0.01 that gives a high similarity reach to 99%.

Figure 8 similarity of different rotated images
6. Conclusions

Target identification process leads to identify a specific object via different positions or orientations. This paper concentrated on image analysis of fluctuation of moment invariants on image based on different object rotation. The implemented approach is constructed via many steps; preprocessing, feature extraction, invariant features, then compared the obtained results to decide the similarity of the tested object. The implemented moment invariants approach leads to efficient target identification results. The obtained results indicated that it is very important to calculate and keep the moment invariants values of the tested images. The obtained results indicated that the similarity value between binary images is about 99% for all images orientations.

References


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